Joint Base Charleston Weapons – Charleston, South Carolina

Joint Base Charleston-Weapons is located in Charleston and Berkeley Counties in the coastal area of South Carolina. The installation is situated in Goose Creek, South Carolina and covers an area of approximately 16,950 acres of contiguous property. The primary mission of JB CHS-Weapons is to enable and sustain warfighter readiness from the shore.

On October 1, 2010, the Air Force officially assumed responsibility for the new Joint Base Charleston, which encompasses the former Charleston Air Force Base and Naval Weapons Station Charleston. The joint base has two sections: Joint Base Charleston Air, which encompasses the former Air Force Base and Joint Base Charleston Weapons, which encompasses the former Navy weapons station.

As part of this permit modification Corrective Actions have been selected for (19) SWMUs and (3) AOCs and post-closure activities modified for (1) SWMU:

Site	Remedy
SWMU 36	Soil: Interim Measure Soil Removal Groundwater: Enhanced reductive dechlorination and groundwater monitoring and Land Use Controls (LUCs)
SWMU 47	Soil: Surficial Debris Removal and Land Use Controls (LUCs)
SWMU 75	Land Use Controls (LUCs)
SWMU 72	Soil: Excavation of debris and Soil Removal and Land Use Controls (LUCs) Groundwater: Confirmation Sampling
SWMU 20	Soil: Surficial Debris Removal and Existing Cover Groundwater: Monitoring and Land Use Controls (LUCs)
SWMU 73	Soil: Excavation of septic tank and soil and off-site disposal Groundwater: In Situ Chemical Oxidation, Monitored Natural Attenuation (MNA), and LUCs
SWMU 82	Soil: Surficial Debris Removal and Existing Cover and Land Use Controls (LUCs)
SWMU 81	Soil: Surficial Debris Removal and Existing Cover and Land Use Controls (LUCs)
SWMU 79	Soil: Surficial Debris Removal and Existing Cover and Land Use Controls (LUCs)
AOC L	Soil: Surficial Debris Removal and Existing Cover and Land Use Controls (LUCs)
SWMU 22	No Further Investigation – Land Use Controls (LUCs)
AOC N	Soil: Surficial Debris Removal and Existing Cover and Land Use Controls (LUCs)
SWMU 67	Soil: Excavation and Off-site Disposal and Land Use Controls (LUCs) Groundwater: Confirmation Sampling
SWMU 7	Groundwater: LUCs
SWMU 69	Soil: Interim Measure Soil Removal and Land Use Controls (LUCs) Groundwater: Monitoring

No Further Action

SWMU 29	SWMU 38	SWMU 40
SWMU 78	SWMU 80	SWMU 84
AOC B-4		

Post-Closure

SWMU 18 – Remedy Modification:
- Discontinue groundwater monitoring and reduction in LUC inspections
- Maintenance of the in-situ cap and notation in installation management plan will still apply

SWMU 36 – Old Southside Hazardous Waste Storage Facility
Contaminants: Tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride
Media: Soil and Groundwater
Proposed Remedy: Interim measure soil removal, Enhanced reductive dechlorination, groundwater monitoring, and land use controls (LUCs)

Site Background

Old Southside Hazardous Waste Storage Facility is in the east-central portion of JBC Weapons, south of the main facility entrance and northeast of the railroad tracks that transect the central portion of JBC Weapons. SWMU 36 is located off Red Bank Road and abuts the motor vehicle pool area and the current Part B-permitted Hazardous Waste Storage Facility. The site supports few structures and has several different ground surfaces, including gravel, asphalt pavement, and grass. A site map of SWMU 36 is included as **Figure 2**.

SWMU 36 operated from the 1940s until 1980, when an Interim Status Hazardous Waste Storage Facility was constructed. During its operation, SWMU 36 was an unpaved site serving as the accumulation point for wastes generated throughout JBC Weapons. The Interim Hazardous Waste Storage Facility was built immediately west of SWMU 36. Through the JBC Weapons RCRA Permit, SWMU 9 operated under interim status authority. This unit operated from 1980 until 1992/1993, when the current permitted hazardous waste storage facility (Building 2332/SWMU 44) was constructed. The Interim Hazardous Waste Storage Facility was later identified as SWMU 9 and was investigated for potential environmental impacts. SWMU 9 was granted a Verification of Clean Closure in 2000, and groundwater concerns associated with SWMU 9 were transferred to SWMU 36. The former location of SWMU 9 is shown on **Figure 2**. SWMU 9 is listed in Appendix A-3 of the RCRA Permit, “SWMUs and AOCs Requiring No Further Action at this Time.”

Site Investigations

Several investigations have been conducted for SWMU 36. A RCRA Facility Investigation (RFI) was conducted in multiple phases between 1998 and 2001. The RFI recommended that a CMS be conducted (TtNUS, 2002). In 2003, a CMS was completed for SWMU 36 including groundwater that was previously included in SWMU 9 (TtNUS, 2003). The recommended alternative in the CMS was monitored natural attenuation (MNA) and LUCs. Between December 2005 and February 2006, additional field investigations were conducted at the site, including groundwater evaluations and collection of a surface water sample. Monitoring recommendations were based on the results of this investigation. Based on the groundwater monitoring results, SCDHEC requested additional investigation prior to finalizing a SoB and modification of the RCRA Permit. Therefore, a data gaps investigation was conducted in June–July 2016, and the results were evaluated in a CMS Report (Bay West, 2017), which replaces the 2003 CMS.

Field investigations were conducted in support of closure of SWMU 9 from November 1994 to February 1999. The work included four rounds of soil sampling and two rounds of groundwater sampling. Four permanent monitoring wells (NWS-9MW-01 through NWS-9MW-04) were installed during the first round of groundwater sampling, and PCE was detected in the groundwater samples from one well. In March 1999, SCDHEC agreed that the groundwater contamination present at SWMU 9 would be addressed under the RFI for SWMU 36 (TtNUS, 2002). Soil data from the investigation results were evaluated in a risk assessment (Harding Lawson Associates, 1999) supporting the Verification of Clean Closure for soil at SWMU 9. Therefore, soils from SWMU 9 were not evaluated further in the SWMU 36 RFI.
A Phase I confirmatory sampling effort was conducted at SWMU 36 in 1997. The work performed during the confirmatory sampling included the installation and sampling of three temporary monitoring wells (36-Q-001 through 36-Q-003) installed downgradient of the former SWMU 36 storage area. The confirmatory sampling report (Brown & Root Environmental, 1997) reported that several organic compounds and inorganics were detected in the groundwater samples indicating that environmental impacts on the

property had resulted from previous site activities. Specifically, PCE and other chlorinated volatile organic compounds (VOCs) were detected in groundwater

The RFI for SWMU 36 was conducted in several stages, beginning in 1998 and ending in February 2001. The RFI included surface and subsurface soil sampling and groundwater sampling at SWMU 36 and groundwater sampling at the area formerly identified as SWMU 9. As part of the RFI, 23 monitoring wells were installed and sampled from SWMU 36, plus four existing wells were sampled at SWMU 9. Additionally, 18 soil borings were sampled; 63 temporary wells were installed and sampled; water levels were measured in all existing and new monitoring wells; and aquifer tests were conducted in 21 of the new monitoring wells. Unacceptable risks for potential future receptors (i.e., hypothetical child and adult resident) were identified due to PCE and its breakdown products in groundwater. The pesticide compound dieldrin was also identified as a contaminant of concern (COC) in the RFI (TtNUS, 2002). MNA was selected as the recommended corrective measure in the 2003 CMS Report, with LUCs to prevent groundwater use (TtNUS, 2003). The CMS Report was approved; however, due to the results of subsequent groundwater monitoring, the SoB and RCRA Permit modification were not completed. Groundwater monitoring and supplemental groundwater investigation were conducted after completion of the 2003 CMS Report. The 2016 annual groundwater monitoring event was conducted concurrently with a data gaps investigation in June–July 2016. The data gaps investigation included installation and sampling of five new monitoring wells to delineate the current extent of the PCE plume. The July 2016 plume extent is shown on **Figure 2**. In addition to the PCE plume, pesticides have exceeded project action levels (PALs) during groundwater monitoring events including the 2016 and 2017 groundwater monitoring events. The pesticide compounds that exceeded PALs were all isomers of hexachlorocyclohexane (BHC), specifically the pesticide lindane (gamma-BHC) and byproducts alpha-BHC and beta-BHC.

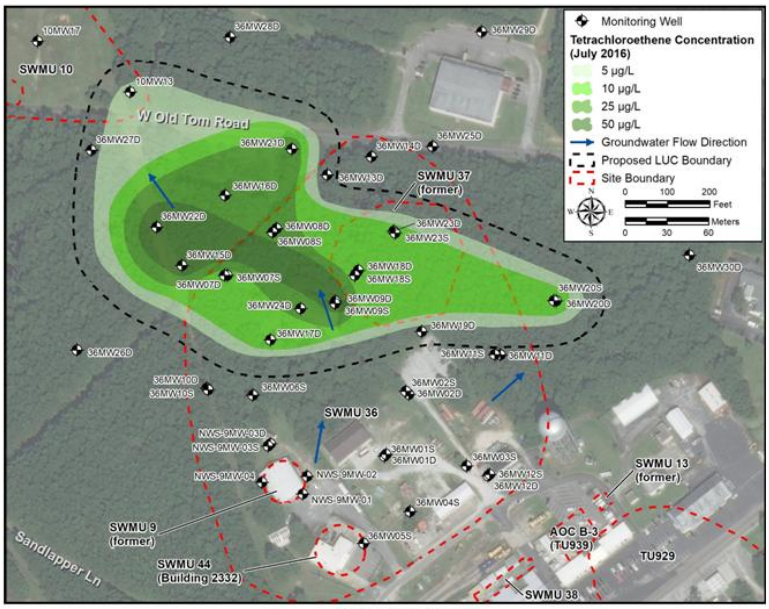


Figure 2. SWMU 36 (SA036) Site Map

Given the low concentrations and scattered locations of pesticide detections, as well as the limited mobility of pesticide compounds, there is no evidence of a source that may have migrated to other areas within SWMU 36. Rather, the scattered detections imply transport to groundwater at locations of historical pesticide application, particularly clearings along Old Tom Road, the fence line, around buildings, and other areas with evidence of prior clearing. Per 40 Code of Federal Regulations (CFR) 261.2(c)(1)(ii), commercial chemical products listed in CFR 261.33 are not solid wastes if they are applied to the land and that is their ordinary manner of use. Both dieldrin and lindane (gamma-BHC) are listed in 40 CFR 261.33(e-f). As byproducts of the production of gamma-BHC, the same consideration applies for alpha-BHC and beta-BHC (40 CFR 261.33[a-b]). The low-level pesticides detected in SWMU 36 groundwater may be indicative of routine application of commercial products rather than site-related wastes, especially given that no source areas or elevated concentrations were identified within the former SWMU 9 and SWMU 36 storage areas (Bay West, 2017).

Summary of SWMU Risks

The human health risk assessment for SWMU 36 was conducted as part of the RFI process. This analysis was conducted to determine possible human health effects (including cancer and direct toxicity) related to exposure to untreated groundwater (drinking and bathing) containing PCE, TCE and cis-1-2-DCE. This analysis served as a baseline assessment to compare the benefits of groundwater remedial actions.

Potentially elevated risks were identified for the hypothetical future residential land use scenario. Potential risks from exposure to PCE, TCE, and cis-1,2-DCE in groundwater were identified as a concern for hypothetical future residents. Cumulative non-carcinogenic hazard indices for the child and adult resident exceeded 1.0, and cumulative incremental lifetime cancer risks for future residents exceeded 1×10^{-4}, the upper limit of the USEPA target risk range (TtNUS, 2002, 2003). Chemicals in soil did not present a significant risk. It was therefore recommended that a CMS be conducted to address constituents in groundwater only.

In addition to chlorinated VOCs, the pesticide compound dieldrin was identified as a COC during the RFI, due to elevated risks for hypothetical future residents calculated based on detection of the compound in groundwater from one monitoring well. A high degree of uncertainty was noted for this result, and short-term monitoring for pesticides was recommended to confirm the presence of dieldrin at the detected location. Dieldrin was subsequently detected only during the first annual groundwater monitoring event in 2008 (Pandey, 2008). Dieldrin was not detected during later monitoring events. The pesticides detected above PALs in recent monitoring events (i.e., isomers of BHC) were not identified as COCs in the baseline human health risk assessment. In addition, the RFI concluded that pesticides detected in SWMU 36 (SA036) groundwater were likely not site-related; rather, they reflect routine historical application of chemicals for pest control on the installation (TtNUS, 2002, 2003).

Based on the results of groundwater analysis conducted in 2016, concentrations of PCE and its degradation products (TCE and cis-1,2-DCE) have decreased since the human health risk assessment was completed in 2002. However, PCE and breakdown products are still the COCs driving risks, and groundwater concentrations continue to exceed PALs. Therefore, the conclusions of the 2002 risk assessment remain valid for evaluation of corrective measures (Bay West, 2017).

The potential for vapor intrusion was evaluated based on the results of 2016 groundwater monitoring and current vapor intrusion guidance (USEPA, 2015). Groundwater monitoring results were compared to vapor intrusion screening levels (VISLs) from the USEPA Calculator Version 3.5.1 based on the May 2016 Regional Screening Levels. A future residential scenario was assumed for calculation of the VISLs, with a target cancer risk of 1×10^{-6} and target hazard quotient of 1. PCE and TCE concentrations exceed their respective VISLs, indicating that the potential for unacceptable risk exists, based on groundwater concentrations. However, since there are currently no complete pathways at SWMU 36 (SA036) for exposure to vapor intrusion (i.e., there are no buildings directly above the groundwater plume or within 100 feet of the plume extent), no unacceptable risks are identified for current receptors. Further evaluation will be needed if construction of a building intended for human occupation is planned within this area in the future, whether for residential or non-residential use.

The screening level ecological risk assessment found that constituents of potential concern do not appear to be widespread throughout the site. Furthermore, no significant aquatic or semi-aquatic habitat exists on or in the immediate vicinity of SWMU 36, and the terrestrial habitat is limited in both quality and quantity. A shallow, intermittent pond on the northern side of the site is too far from the original storage area to be impacted by storage area runoff. Moreover, even if ecological receptors were present, impacts from the primary groundwater constituent, PCE, would be nominal because VOCs do not bioaccumulate or biomagnify. Most of the original storage area is covered with gravel, buildings, roadways, and mowed turf grass. As a result, ecological risks do not appear to be present (TtNUS, 2003).

Proposed Corrective Action

Alternative 3 – Enhanced Reductive Dechlorination, Groundwater Monitoring, and LUCs would be the best remedial action for SWMU 36. A description is below:

Enhanced Reductive Dechlorination: Enhanced reductive dechlorination is an active remedial approach that may combine multiple *in situ* technologies to degrade PCE and its degradation products via reductive biological and/or chemical processes. This process will include injection of an organic carbon substrate and reactive iron into the aquifer to create anaerobic and reducing conditions suitable for enhanced *in situ* bioremediation and chemical reduction of PCE. The reactive iron component will consist of zero valent iron slurry or water-soluble iron compounds to promote chemical reduction of chlorinated VOCs. Other amendments may be used to provide pH buffer, additional nutrients, or bioaugmentation cultures. The organic carbon substrate, reactive iron, and amendments (if needed) would be delivered to the subsurface

via direct push injection methods, with injection locations designed to intercept groundwater flow at multiple locations within the plume in order to provide treatment.

Groundwater Monitoring: A performance monitoring program will be implemented to monitor progress of the corrective measures. In addition, the corrective measures will include long-term monitoring of pesticides in groundwater as requested by SCDHEC.

LUCs: LUCs will be implemented to restrict the use of site groundwater and to require further evaluation of vapor intrusion risks if construction is planned in the future. Since groundwater treatment is planned under this alternative, the potential for vapor intrusion may be reevaluated based on changes in groundwater concentrations. This LUC may be amended or removed in the future if it is determined that groundwater concentrations no longer pose a concern for vapor intrusion. The specific LUCs include:

- Logging the LUC boundaries (inclusive of all polygon coordinates) and use restrictions (restricting site groundwater to non-potable uses and, if construction intended for human occupation is planned, requiring further evaluation of vapor intrusion risks and imposing any necessary mitigation) into the Base geographic information system to officially identify the site as being impacted by groundwater contamination and to prompt RPM reviews of any proposed disturbance or new use of the site. The review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If land disturbing activities impact an ERP site, the RPM will contact SCDHEC for notification as specified in the RCRA Permit.
- Annual LUC inspections to verify that no construction or well installation has occurred at the site without proper review initiated with the Civil Engineer Squadron dig permit process.

  At a minimum, an annual report will be submitted summarizing the field events that took place at the site during that year. In some cases, it may be an inspection letter/report. In other cases, it will also include the reporting of groundwater samples collected. The report will also discuss if there has been a change in land use during the reporting period.

Anticipated Impacts of Cleanup on the Local Community

No significant impacts to the local community are associated with the proposed remedy at SWMU 36.

SWMU 47 – Southside Drum Disposal Area
Contaminants: None
Media: Soil
Proposed Remedy: Surficial Debris Removal

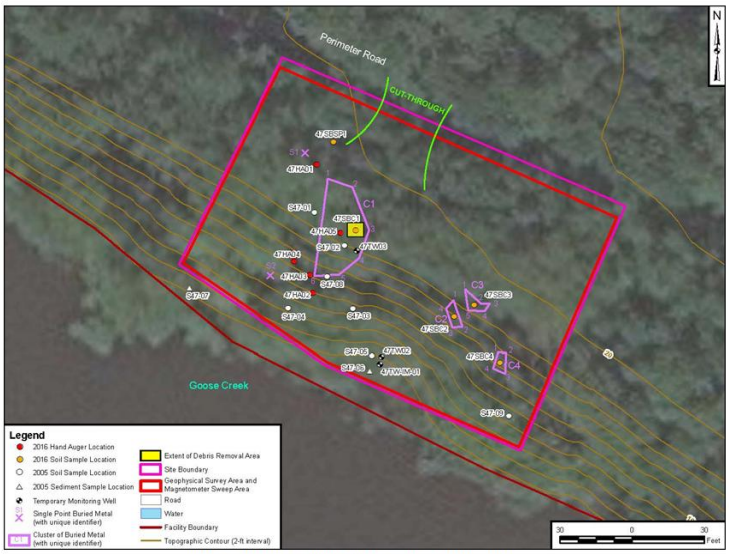


Figure 2. SWMU 47 (DA013) Site Map and Debris Removal Areas

Site Background

SWMU 47 is located in the south-central portion of the facility about 1 mile south of Red Bank Road. The site consists of a heavily wooded area with mixed vegetation and wetland vegetation along the shoreline of Goose Creek.

Site Investigations

Several investigations have been conducted at SWMU 47. During a facility-wide confirmation sampling event in 1997, one temporary groundwater well point was installed and sampled, and one subsurface soil sample was collected at SWMU 47 (Brown & Root Environmental, Inc., 1997). One semi-volatile organic compound (SVOC), bis(2-ethylhexyl) phthalate (BEHP), was detected in the groundwater sample, and low levels of volatile organic compounds (VOCs) were detected in the subsurface soil sample. Based on these results, a second confirmatory sampling investigation was recommended. During the Confirmatory Sampling Phase II Investigation (Tetra Tech, 2000), one temporary well point was installed at the same location as the 1997 well point and sampled only for SVOCs; additionally, one soil boring was installed near a drum that contained asphalt-like material and surface and subsurface soil samples were collected. Polycyclic aromatic hydrocarbons (PAHs) were detected in the surface soil sample and VOCs were detected in the subsurface soil sample. PAHs were not detected in the subsurface soil sample. Because BEHP was not detected in the groundwater sample collected during the Confirmatory Sampling Phase II Investigation, it was determined that the previously detected concentration was not site related.

An IM was conducted in 2005 to remove approximately 10 cubic yards of surface debris and 15 partial/intact and empty steel drums (TolTest, 2005). Following the IM, confirmatory soil, Goose Creek sediment, and groundwater samples were collected. Concentrations of PAHs in one soil sample and thallium in one soil sample exceeded residential screening and background levels in place at that time; however, there were no other analytes detected at concentrations that exceeded residential screening criteria in soil. Only BEHP was detected at a concentration exceeding the human health screening criterion in place in 2005 in groundwater. Acetone and methoxychlor were the only organic constituents detected in one of the two sediment samples, but only acetone was detected at a concentration greater than the ecological screening criterion. Metals were detected in both sediment samples, none of the metals were detected at concentrations exceeding ecological screening criteria. Arsenic and chromium were the only metals detected in sediment samples at concentrations greater than human health screening criteria.

No sampling was conducted during the RFI at SWMU 47, although an evaluation of previously collected data was conducted (Tetra Tech, 2011a). No further investigative field work was recommended for SWMU 47 in the RFI report; however, drum and debris removal was recommended.

A CMS was completed in 2011 to evaluate remedial alternatives for soil and groundwater (Tetra Tech, 2011b). Based on evaluations completed as part of this study, excavation and removal of drum remnants and any underlying stained soil were chosen as the recommended remedial alternative. SCDHEC provided comments on the CMS Report and agreed that the drum and any contaminated soil should be removed from the site, but commented that an investigation to determine the presence of buried drums and subsurface soil contamination needed to be conducted. SCDHEC conditionally approved the CMS Report on the basis that the investigation would be conducted. None of the corrective measures identified in the

conditionally approved 2011 CMS were implemented pending completion of the required additional data collection.

Based on comments received from SCDHEC on the conditionally approved 2011 CMS, a CMS Work Plan was developed to determine the presence of buried drums and evaluate potential contamination of soil or groundwater near the drums or drum remnants (Tetra Tech, 2016). During the 2016 CMS Investigation, a geophysical survey was conducted, soil samples were collected at the locations of geophysical anomalies, and two temporary groundwater monitoring wells were installed and sampled (Tetra Tech, 2017).

During the geophysical survey, four potential buried metal clusters and two potential buried metal points were identified (see **Figure 2**). Following the geophysical survey, a magnetic locator instrument and visual observations were used to verify the geophysical anomalies and to identify soil sample locations. Hand augering to depth was also performed in areas where the magnetic locator signaled a response to determine if any buried items were present and to aid in identifying soil sample locations.

There were no exceedances of PALs in 2016 groundwater samples. The 2005 temporary monitoring well that had one PAL exceedance of BEHP was located near 2016 temporary monitoring well 47TW03 in which BEHP was not detected. While there was one exceedance of a soil PAL noted in the 2005 data, there were no exceedances noted in the 2016 data. The locations of 2016 soil samples were biased to areas where anomalies were identified during the geophysical survey. Furthermore, the location of the 2005 soil sample in which the PAL exceedance was noted is within anomaly area C1, which is where the 2016 soil sample collected at 47SBC1 was located, and no PAL exceedances were noted in this sample.

Summary of SWMU Risks

No COPCs were identified during the 2016 CMS Investigation risk screening, data was screened for the hypothetical future residential scenario. Therefore, further evaluation of risks was not required.

Soil and groundwater concentrations at SWMU 47 are acceptable; however, drum remnants remain at SWMU 47.

Proposed Corrective Action

It has been determined that Alternative 3 – Debris and Drum Remnants Removal and Disposal would be the best remedial action for SWMU 47. Alternative 3 includes the removal of debris and drum remnants identified during the 2016 CMS Investigation, and the subsequent off-site disposal of removed materials. It is assumed based on analysis of investigation-derived soil waste that any excavated soil would be classified as non-hazardous waste. After excavation and disposal, the area would be graded and restored. Alternative 3 would be reliable and effective over the long term because no chemicals were detected at concentrations exceeding PALs, and because the drum remnants would be removed from the site. The removal of drum remnants under this alternative results in a limited potential for on-site workers to be exposed to source material during the removal. However, use of safe digging techniques and appropriate use of personal protective equipment would adequately protect site workers from these potential hazards. Qualified contractors for the debris and drum remnants removal are readily available. Preparation of a Corrective Measures Implementation Plan and a land disturbance permit application would also be required prior to the removal effort.

Alternative 3 is the recommended corrective action at SWMU 47 because it meets the CMOs and ensures that corrective actions taken at SWMU 47 sufficiently reduce and/or eliminate risks to human health and the environment by removing remaining debris and drum remnants. The identified drum remnants to be removed are shown on **Figure 2**. Excavated drum remnants would be transported for off-site disposal and the excavated area would be backfilled first with sand and then with topsoil, and graded to match the existing grade. The area would then be seeded with native grass.

Anticipated Impacts of Cleanup on the Local Community

No significant impacts to the local community are associated with the proposed remedy at SWMU 47.

SWMU 75 – South Annex Mustard Gas Barges
Contaminants: identified. Barges remain submerged (i.e., waste in place).
Media: None
Proposed Remedy: Land use controls (LUCs)

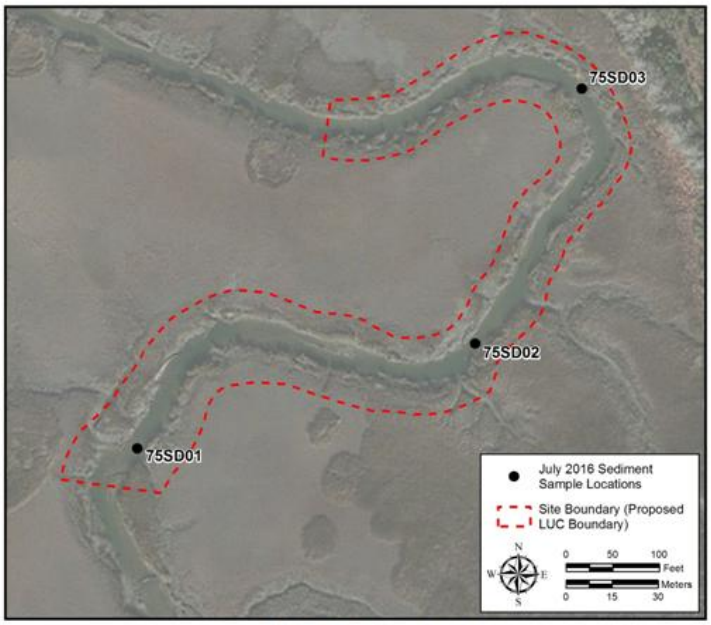


Figure 2. SWMU 75 (ZZ075) Site Map

Site Background
SWMU 75 – South Annex Mustard Gas Barges is located north of Goose Creek in the South Annex of JBC Weapons. SWMU 75 is approximately 6 acres (**Figure 2**) and comprises five or six barges that were burned in a small tidal tributary of Goose Creek. The barges are currently submerged.

After World War II, the South Annex (formerly the Charleston Ordnance Depot and Charleston Army Depot) received mustard agents from other installations and transferred these agents to barges at the depot docks. Based on historical documents, containers of mustard agents passed through the dock facilities, but were never stored in warehouses or magazines at the depot. In 1946, the barges were towed to sea and the mustard agent containers were disposed of at sea. After the operation, the five or six barges were decontaminated by rinsing with seawater, and then taken to a tributary north of Goose Creek and burned (Naval Weapons Station Charleston, 1997).

Site Investigations

Several rounds of assessment and investigation were completed for SWMU 75 beginning in 1997. The 1997 Draft RCRA Facility Assessment (Naval Weapons Station, 1997) indicated that the presence of mustard gas and its agent breakdown products (ABPs) originating from SWMU 75 was highly unlikely in Goose Creek and recommended no further action at the site. However, SCDHEC requested that confirmatory sampling be performed for SWMU 75.

SWMU 75 was investigated in 2009, and the results were first presented in a site inspection (SI) report for multiple sites (TtNUS, 2010). A more thorough presentation and evaluation of the SI results for SWMU 75 were presented in the SWMU 75 SI Addendum (Bay West, 2014). The SI Addendum provided results for three sediment samples collected from the tributary to Goose Creek in December 2009. Each sample was analyzed for mercury, due to concerns that mercury may have been stored in the mustard containers prior to mustard storage. Mercury was detected in each sample; however, the concentrations were below the project action level of 0.13 milligrams per kilogram. The SI Addendum recommended additional sampling for sulfur mustard and related compounds at SWMU 75.

The recommended sampling was completed in 2016 and the results were reported in the *Site Inspection Addendum and Remedy Selection Document for SWMU 75* (Bay West, 2016). Sediment samples were collected from three locations (**Figure 2**) within the tributary to Goose Creek and were analyzed for sulfur mustard, lewisite, and their ABPs. Sample results were non-detect for all parameters analyzed. Based on the results of investigation activities completed in 2009 and 2016, no contamination has been identified at SWMU 75.

Summary of SWMU Risks
No contamination has been identified at SWMU 75. Therefore, no risks have been identified for current or potential future receptors. However, sampling cannot be completed directly beneath the barges as long as they remain in place. The barges were placed in the tributary in 1946 and have become entrenched in the

sediment. Removal could potentially cause significant disturbance to the tributary and adjacent marsh, and is not being considered at this time. A removal action would require further evaluation if it is considered at some point in the future.

Since sampling cannot be completed directly beneath the barges as long as they remain in place, LUCs should be implemented at SWMU 75 to require further investigation if the barges are removed or disturbed at some point in the future.

Proposed Corrective Action

LUCs are the proposed remedy for SWMU 75. LUCs will be implemented to prohibit the disturbance or removal of the barges or the soil under the barges unless further investigation and risk assessment is conducted to evaluate any potential risks present in the sediments under the barges. LUCs are documented in the Installation Development Plan, including the Base geographic information system. The Base Remedial Project Manager (RPM) works with the 628th Civil Engineer Squadron Base Community Planner to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections will be performed to confirm compliance with the LUCs (see details below). The specific LUCs are:

- The Installation Development Plan shall be amended to state that if the barges are removed or disturbed, further investigation and risk assessment will be required to evaluate any potential risks present in the sediments under the barges. A plan for the required investigation and risk evaluation must be approved by SCDHEC before removal or disturbance of the barges begins.
- The LUC boundaries (inclusive of all polygon coordinates) will be logged into the base geographic installation system to officially identify the site as being subject to a use restriction and to prompt RPM reviews of any proposed disturbance or new use of the site.
- The RPM will review any project plans that may disturb SWMU 75. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. The RPM will also review plans for projects located at the site to determine if additional protections are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.
- If land disturbing activities impact an ERP site, the RPM will notify SCDHEC as specified in the RCRA Permit.
- The Base shall conduct annual LUC inspections to ensure that no human activities are taking place in the unnamed tributary that would disturb the barges. The annual inspection shall include an administrative review and visual observation of SWMU 75 to the extent that it is visible on land from the opposite bank of Goose Creek.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 75.

SWMU 72 – South Annex Abandoned Drum Area – 1st and A Ave.
Contaminants: : benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene
Media: Surface Soil
Proposed Remedy: Excavation of Debris and Soil Removal and Confirmation Sampling

Site Background
SWMU 72 – South Annex Abandoned Drum Area was formerly a multiple-track rail yard, the rails have since been removed; however, remnants of railroad ties and other debris remain scattered throughout the site. The site is now covered by large trees and thick underbrush. A site map of SWMU 72 is included as **Figure 2**.

Site Investigations

Several investigations have been conducted at SWMU 72. A RCRA Facility Assessment (RFA) was completed in 1997 (WPNSTA Charleston, 1997). During the RFA, twelve 55-gallon drums and two 30-gallon drums were discovered at the site, and two soil samples were collected. Sample analysis showed no evidence of suspected creosols or pentachlorophenates in the soil. No VOCs or SVOCs were detected in either soil sample. Numerous metals were detected; however, only arsenic exceeded its screening criterion but was less than the facility background concentration. The RFA recommended additional sampling to determine if contamination was present at the site, and it was also recommended that the drums be removed. Interim Measures (IM) were conducted in 2005. SWMU 72 IM activities included removal of surface debris and 15 drums; disposal of oily liquid found in two drums; confirmatory soil sampling; and installation of temporary monitoring wells (TolTest, 2005). It was recommended that a RCRA Facility Investigation (RFI) be implemented at SWMU 72 to determine the nature and extent of soil and groundwater contamination, and to characterize the shallow aquifer.

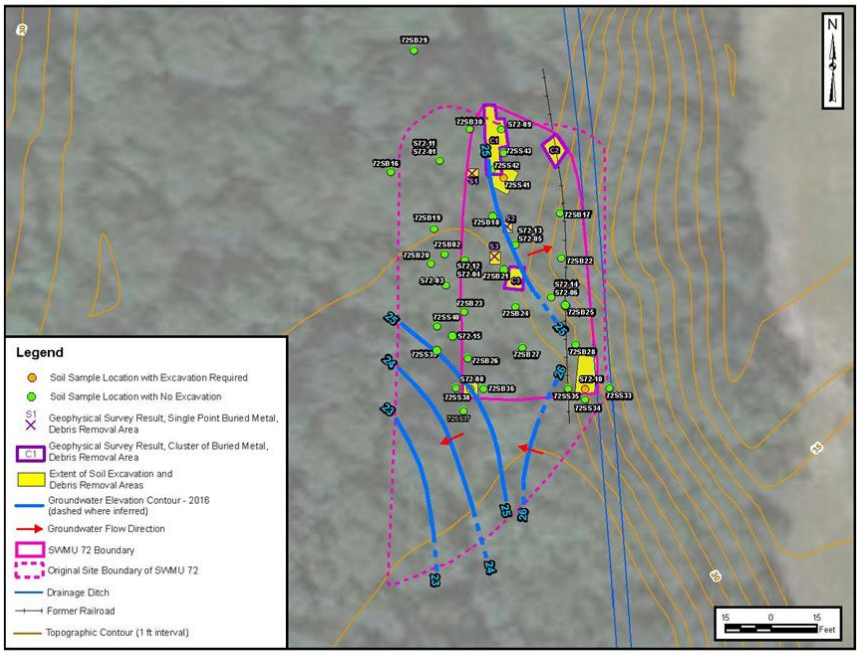


Figure 2. SWMU 72 (SA072) Site Map and Soil Excavation and Debris Removal Areas

An RFI was conducted in 2009 (Tetra Tech, 2011a). Soil and groundwater samples were collected from 15 soil borings and seven temporary wells. Data collected following the IM in 2005, and during the RFI were combined for evaluation. Semi-volatile organic compounds (SVOCs) were detected in several surface and subsurface soil samples. Concentrations of SVOCs, particularly polycyclic aromatic hydrocarbons (PAHs), exceeding screening and facility background levels were identified in soil samples collected near two railroad tie locations and the metal pile in the southern end of the site. Pesticides and metals were detected in most soil samples; however, only one pesticide (chlordane) and one metal (arsenic) were detected at concentrations that exceeded screening and facility background levels. Several metals were detected in the groundwater at concentrations exceeding screening and facility background levels. No further investigation was recommended for subsurface soil, and removal of two PAH-contaminated surface soil areas was recommended. Further investigation of metals (arsenic, lead, cobalt, and chromium [total and hexavalent]) in groundwater was recommended in the RFI.

Five permanent monitoring wells were installed at SWMU 72 in 2011; surface and subsurface soil samples were also collected from two of the monitoring well borings (Tetra Tech, 2011b). Arsenic, cobalt, and lead were detected in groundwater samples collected during this event. Concentrations of these metals in groundwater were significantly less than the concentrations detected during the RFI. Hexavalent chromium was not detected in groundwater during this event, but detection limits for hexavalent chromium in some groundwater samples were greater than the screening criterion, so the presence of hexavalent chromium in groundwater could not be definitively determined. Continued monitoring of total and hexavalent chromium, arsenic, cobalt, and lead was recommended to track potential migration to downgradient wells; and to confirm that contaminant concentrations are stable or decreasing.

A CMS was completed in 2011 to evaluate remedial alternatives for soil and groundwater (Tetra Tech, 2011c). Based on evaluations completed as part of this study, excavation and removal of contaminated surface soil (three hot spot areas), land use controls (LUCs) for groundwater, and short-term monitoring of groundwater were chosen as the recommended remedial alternatives. SCDHEC agreed with the recommendation to remove contaminated surface soil at SWMU 72, but requested an investigation into the presence of buried drums at SWMU 72. SCDHEC conditionally approved the CMS Report on the basis that the investigation would be conducted. None of the corrective measures identified in the conditionally approved 2011 CMS were implemented pending completion of the required additional data collection.

A round of groundwater samples was collected in 2012. Bis(2-ethylhexyl)phthalate was detected in three monitoring wells, and lead was detected in two monitoring wells (TEC-BSC Joint Venture, 2013). Both analytes were detected at concentrations less than screening criteria.

Based on comments received from SCDHEC on the conditionally approved 2011 CMS, a CMS Work Plan was developed to determine if buried drums remain at the site, and to confirm excavation area(s) and volume (Tetra Tech, 2016). During the 2016 CMS Investigation, a geophysical survey was conducted, surface soil samples were collected near geophysical anomaly locations and at the soil hot spot locations, and the five permanent wells at SWMU 72 were sampled (Tetra Tech, 2017a). Groundwater samples were also analyzed for hexavalent chromium to determine its presence or absence in groundwater.

Most of the geophysical survey data appeared non-anomalous; however, several anomalies were interpreted to be potentially large enough to represent buried drums. As shown on **Figure 2**, three clusters of buried material and three single points of buried material were identified. Soil samples were collected around the railroad ties/metallic debris pile present in area C1 shown on **Figure 2**.

SVOCs were detected in several surface and subsurface soil samples collected at SWMU 72 during all site investigations. Concentrations of SVOCs, particularly PAHs exceeding project action levels (PALs) and facility background levels were noted in soil samples from the southern, central, and northern portions of the site. These SVOCs were not detected in the groundwater. Pesticides were detected in most soil samples; however, only one pesticide, chlordane, was detected in one surface soil sample at a concentration that exceeded its PAL. Pesticides were not detected in the groundwater. Metals were detected in all soil samples; however, only one metal, arsenic, was detected in two surface soil samples at concentrations that exceeded the PAL and facility background levels.

Permanent monitoring wells were installed at SWMU 72 in 2011 and were sampled in 2011, 2012, and 2016. All analytes except for hexavalent chromium (which was determined to be a false positive) were measured at concentrations less than the greater of the PALs and facility background in all three rounds of groundwater monitoring.

Summary of SWMU Risks

The human health risk screening evaluation (HHRSE) for SWMU 72 was initially conducted as part of the RFI process and concluded that risk estimates for residential exposures to PAHs in surface soil exceeded risk management benchmarks. The HHRSE was updated as part of the CMS Investigation (Tetra Tech, 2017a). All groundwater concentrations were less than the greater of the PALs and facility background in all three rounds of groundwater monitoring; therefore, an evaluation of risks posed by exposure to SWMU 72 groundwater was not warranted, and only a soil risk evaluation was completed. The HHRSE was also updated because new United States Environmental Protection Agency (USEPA) default exposure assumptions (used to estimate risks) for some exposure factors had been published, toxicity criteria for

some chemicals had been updated, and the USEPA regional screening levels (RSLs) had been updated since the RFI report (Tetra Tech, 2011b) was completed. Additionally, the Basewide Facility Background (background) concentrations were updated in 2017 (Tetra Tech, 2017b).

The surface and subsurface soil cancer risks assume a future resident is exposed to chemicals of potential concern (COPCs) in surface and subsurface soil, and exceeded the target risk management level of 1 X 10^{-5}. The hazard index (HI) for future residential exposure to surface soil and subsurface soil are less than the risk management benchmark of 1 (i.e., unacceptable non-cancer risks are not anticipated).

Because cancer risks for exposures to surface soil and subsurface soil exceed acceptable levels, MCSs for soil COCs were developed. The MCSs correspond to cancer risk levels for USEPA's target risk range of 10^{-4} to 10^{-6} and a hazard quotient of 1; therefore, MCSs were only calculated for analytes whose risk level exceeded the USEPA target levels. The recommended MCSs are based on the target risk management levels of 1 X 10^{-5} or an HI of 1.

Proposed Corrective Action

It has been determined that Alternative 2 – Excavation and Disposal would be the best remedial action for SWMU 72. A description is below:

Soil Alternative 2 is the corrective measure selected to address contaminated surface soil and debris at SWMU 72 in the Focused CMS Report (Tetra Tech, 2017a). Soil Alternative 2 includes the excavation and removal of surface debris and contaminated surface soil, and transportation and off-site disposal with treatment as necessary. It is assumed based on analysis of investigation derived soil waste that the excavated soil would be classified as non-hazardous waste. Prior to excavation, the surface would be cleared and grubbed. Next, surface debris such as railroad ties and metallic debris would be removed for off-site disposal. Limits of the excavation and debris removal areas are shown on **Figure 2**. The maximum depth of the excavation is expected to be 1 foot below ground surface (bgs) in soil excavation areas, and up to 6 inches bgs in debris removal areas. Confirmation sampling would be conducted following excavation to confirm that MCSs have been met. In addition, the subsurface beneath the surficial debris would be investigated following the debris removal to confirm that no additional buried debris is present. Approximately 5.96 cubic yards of soil and 4.50 cubic yards of debris would be excavated at SWMU 72 and disposed off-site. After excavation and disposal, the area would be graded, restored, and reseeded with grass.

Additionally, while hexavalent chromium was not retained for further evaluation in the Focused CMS and groundwater does not require corrective action at SWMU 72, hexavalent chromium at two groundwater wells (72MW02 and 72MW04) would be investigated during implementation of the soil remedy to confirm hexavalent chromium is not present.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 72.

SWMU 20– Old South Annex Munitions Wash Area
Potential Contaminants Investigated: Munitions and explosives of concern (MEC), munitions debris (MD) munitions constituents (MC), and non-munitions-related debris (NMRD)
Media: Soil, sediment, groundwater, and surface water
Proposed Remedy: Soil: Surficial Debris Removal and Existing Cover; Groundwater: Annual Groundwater Sampling; Land use controls (LUCs)

Figure 1: Facility and SWMU 20 Location Map

Site Background

SWMU 20 occupies approximately 4 acres along Goose Creek in the southern portion of the JBC Weapons facility. Historical information suggested that projectile filling and complete round assembly activities were conducted at the site. Grenades and 75 millimeter (mm) through 155mm rounds were reportedly demilitarized by the Army at SWMU 20 from 1918 until 1952. During this period, propellant residue was reportedly washed from shell casings on a concrete pad. The area has been inactive for more than 50 years. SWMU 20 currently includes undeveloped land. Goose Creek and adjacent marshland are located in the eastern portion of an otherwise forested MRS. The MRS encompasses the area of former Buildings T643, T645, and T647. A Space and Naval Warfare Command (SPAWAR) System Command Center antenna farm was installed in proximity to the western portion of the MRS and some trees were cleared within SWMU 20 in 2009 to improve reception. There are numerous buildings associated with SPAWAR west of SWMU 20. There are no plans to further develop the area within the SWMU 20 boundaries. According to the Installation Development Plan for JBC Weapons, the long-term planned used for this site is to maintain it for use as an open space/buffer area.

Site Investigations

The objective of the RI was to further investigate the results and conclusions of previous investigations and the MMRP IRA (URS, 2015) completed at SWMU 20, to quantify the impacts of MEC and/or MC and, if present, to delineate the nature and extent of munitions-related contamination, in order to evaluate any associated risks to human health or the environment. Comprehensive visual survey, subsurface investigation (involving the use of technology that images underground metallic objects and the excavation of those objects), and MC sampling were all completed at SWMU 20 as part of the RI following the IRA surface clearance. The Summary of Risks presented in the following section is based on the cumulative results of the RI at SWMU 20 as documented in the JBC Weapons RI/FS Report (URS, 2016).

Summary of SWMU Risks

No evidence of MEC, MD, or range-related debris was observed at SWMU 20 during the MMRP IRA or RI fieldwork. However, an abundance of NMRD, including concrete and railway debris, was identified during the MMRP fieldwork. Visual evidence indicated that NMRD may have been disposed of at SWMU 20, but based on the associated activities were not considered to be munitions related and did not appear to be potential sources of chemical contaminants. The RI/FS concluded that no additional MEC investigation activities were warranted at SWMU 20.

Based on potentially elevated concentrations of explosives constituents and metals observed in previous SI samples (TtNUS, 2010), the RI media of concern for MC sampling at SWMU 20 included soil, sediment, groundwater, and nearby surface water. Based on this, media samples were analyzed for explosives constituents and/or target metals during the RI.

Slightly elevated explosives constituents and metals concentrations in soil and groundwater were delineated as part of the RI at SWMU 20. RI human health and ecological risk assessments evaluated the combined SI and RI MC sample results for risks to potential SWMU 20 human and ecological receptors. No unacceptable risks were identified in soil, sediment, groundwater, or surface water for human receptors. Although construction workers could be exposed to low-level explosives constituent concentrations identified in groundwater at SWMU 20, none of the detected concentrations exceeded Regional Screening Levels for construction worker exposure. Groundwater at SWMU 20 is not currently used as a drinking water source, nor is it likely to be used in the future. Based on this, exposure to the low-level explosives constituent concentrations observed in groundwater at SWMU 20 is considered minimal (URS, 2016). However, because a cadmium concentration detected in groundwater at the MRS exceeded the Safe Drinking Water Act MCL and explosives constituent concentrations detected in groundwater exceeded USEPA RSLs (for tap water), groundwater monitoring is included as part of the LUCs Remedy for SWMU 20 (URS, 2016).

Lead and chromium in soil were retained as constituents of potential concern (COPCs) for further evaluation in the ecological risk assessment. Cadmium, chromium, copper, lead, and zinc were also retained as COPCs in sediment. However, no munitions-related sources of these COPCs have been identified, since no evidence of MEC, MD, or range-related debris was found at SWMU 20 during the MMRP IRA or RI fieldwork. Groundwater was also evaluated in the ecological risk assessment, based on the potential to adversely impact adjacent surface water sources, but no COPCs were identified, and surface water samples were non-detect for all analytes. Based on further evaluation and risk estimations for mammals, birds, and plants, it was concluded that no unacceptable risks were identified for the COPCs evaluated in soil at SWMU 20. Of the metal COPCs detected in sediment at SWMU 20, only zinc exceeded its respective probable effects limit based on two elevated concentrations (i.e., hotspots) observed in previously analyzed SI samples (TtNUS, 2010). These samples were thoroughly delineated by low levels of zinc identified in surrounding RI samples. Because elevated zinc concentrations were localized within a small area, no unacceptable risks were identified for the COPCs evaluated in sediment at SWMU 20. Therefore, no unacceptable risks were identified by the RI for ecological receptors (URS, 2016).

The RI/FS concluded that a significant quantity of NMRD had been left in place at SWMU 20. Most of the surface NMRD left in place at SWMU 20 was related to utilities or piping and construction materials (e.g., concrete and rebar). Many of these materials were likely associated with former buildings and an abandoned railway that are no longer present at the MRS.
Subsurface anomaly locations investigated included embedded or buried site features/NMRD items that were also left in place following inspection during the subsurface RI fieldwork. Most of the subsurface NMRD left in place at SWMU 20 was related to an abandoned railway that transected the MRS. The NMRD left in place at SWMU 20 did not include significant sources of chemical contaminants. The NMRD was left in place due to access limitations, safety considerations, and to minimize disturbance to the wetland and forest environments.

Proposed Corrective Action

Remedial Action Objectives (RAOs) specify the contaminants and media of interest, exposure pathways, and preliminary remediation goals (PRGs) that guide the development of a range of alternatives. The RAO for SWMU 20 focuses on addressing potential physical hazards associated with NMRD left in place at the MRS. NMRD identified at SWMU 20 included abandoned utilities, construction materials, scrap metal, and railroad debris.

It has been determined that Alternative 2 - LUCs and Groundwater Monitoring would be the best remedial action for SWMU 20._Based on information currently available, the USAF believes that NMRD Alternative

2 (LUCs) including groundwater monitoring meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The USAF expects that the Preferred NMRD Alternative of LUCs and groundwater monitoring will satisfy the statutory requirements of CERCLA (i.e., protection of human health and the environment and compliance with ARARs) and the existing RCRA Permit (i.e., LUCs are required for NMRD waste left in place and for groundwater monitoring of cadmium and explosives constituents). NMRD Alternative 2 includes groundwater monitoring and developing and maintaining LUCs for SWMU 20. An LUC Implementation Plan (LUCIP) would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. LUCs would consist of institutional controls, including administrative mechanisms such as restrictions to prevent unauthorized excavation or groundwater use within the MRS. Controls would be maintained, as needed, through future property transfers or until NMRD concerns have been addressed. LUCs are documented in the Installation Development Plan. The Base Remedial Project Manager (RPM) works with the 628 Civil Engineer Squadron Base Community Planner (Base Community Planner) to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities).

Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb SWMU 20. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If land disturbing activities impact an Environmental Restoration Program site, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Groundwater monitoring would include the installation and sampling of monitoring wells near the south end of the MRS where cadmium and explosives constituents have been detected at concentrations exceeding the MCL or RSLs (URS, 2016). The wells would be sampled on a periodic basis for cadmium and explosives constituents (1,3-dinitrobenzene, 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, and nitrobenzene). The number and placement of groundwater monitoring wells, as well as the frequency of sampling and analysis, will be determined in the Corrective Measures Implementation Work Plan. It is assumed that monitoring wells initially will be sampled annually. Groundwater monitoring results would be reported in Annual LUC Inspection Reports for SWMU 20. Annual groundwater monitoring would continue until the RCRA permit is modified with an alternative approach, or sampling becomes unnecessary (e.g., due to natural attenuation) and is discontinued with SCDHEC approval. Based on the results and conclusions of the RI/FS Report (URS, 2016), it is currently anticipated that annual groundwater monitoring for cadmium and explosives constituents would be sufficient.

Annual LUC inspections would be completed. Because the NMRD identified and left in place at this site is not considered to be a significant human health hazard, signs are not warranted as part of the LUC remedy at SWMU 20.

Future decisions about land use would drive long term management (LTM) requirements. For example, if land use changed from undeveloped to residential or some other use (unlikely for SWMU 20 based on its wetland terrain), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 20.

SWMU 73: South Annex Building 3440, Battery Shop
Contaminants: Soil: arsenic; Groundwater: arsenic and iron
Media: Soil and Groundwater
Proposed Remedy: Excavation and Off-Site Disposal of Septic Tank and Soil and *In Situ* Chemical Oxidation, Monitored Natural Attenuation (MNA), and Land Use Controls (LUCs) for Groundwater

Site Background

Building 3440 was constructed in 1941 as an "Inert Storage Warehouse," but by 1970 was being used as a "Battery Storage, Administrative, and Battery Shop." It is unknown when the building began to be used for this latter purpose. The base point of contact at the time the RFI was completed speculated that battery storage became a need for the depot when its mission changed to transportation in approximately 1952. The base sanitary sewer map, dated 1 September 1970, shows a septic tank at the southern end of Building 3440 labeled "43." A construction drawing for the building could not be located. The septic tank was shown to be a 1,000-gallon concrete septic tank, similar to others used at the base. Numerous site investigations, including the 2016 Corrective Measures Study (CMS) Investigation, have confirmed contamination of site soil and groundwater.

Site Investigations

Several investigations have been conducted at SWMU 73. A RCRA Facility Assessment (RFA) was completed in 1997 (WPNSTA Charleston, 1997). During the RFA, one soil sample was collected at the site, downhill from the estimated location of the septic tank, and analyzed for Appendix IX metals. Based on the concentration of lead measured in this sample, the RFA recommended that the septic tank be removed and samples collected. Interim Measures (IM) were conducted in 2005. At SWMU 73, 10 test trenches were excavated but the septic tank was not located; soil samples were collected in the area of the suspected septic tank near the building's loading area. Because the septic tank could not be located, TolTest performed a dye tracer test with Navy personnel and confirmed that Building 3440 is connected to the base's sanitary system. It was recommended that an RFI be implemented at SWMU 73 to determine the nature and extent of surface contamination adjacent to the southwestern end of Building 3440; and to characterize the shallow aquifer in the area of Building 3440 associated with the septic tank itself.

An RFI was conducted in 2009 (Tetra Tech, 2011a). Soil and groundwater samples were collected, with screening criteria exceedances noted in both media. Chromium was the only contributor to estimated unacceptable risk in soil with an exceedance occurring at only one location. The RFI recommended either a hot spot removal or resampling of soil for hexavalent chromium at this location. Metals were detected in all groundwater samples; however, arsenic and lead were the only metals detected at concentrations greater than screening criteria and facility background levels. Groundwater monitoring for arsenic and lead, and additional investigation to delineate the arsenic and lead plumes, were recommended in the RFI.

Eight permanent monitoring wells were installed at SWMU 73 in 2011 (Tetra Tech, 2011b). Arsenic was detected in groundwater at five monitoring wells and lead was detected in groundwater at two monitoring wells; however, only two groundwater samples had low-level arsenic concentrations in exceedance of drinking water screening criterion. It was recommended that the two monitoring wells which had been planned for installation in 2011 (but were not installed) be installed to delineate the plume, and that a long-term monitoring (LTM) plan be prepared for SWMU 73 (FL073). Additionally, because surface water in Charlie's Pond was not sampled, it was recommended that the LTM plan also evaluate the viability of sampling pore water and/or nearby surface water. It was also recommended that if pore water sampling was conducted, that the pore water be collected from a temporary, hand-installed, pre-packed well point (to be installed during each LTM sampling event) at the water's edge; and that surface water sampling potentially be included in LTM plan based on the sample results. However, based on recent groundwater monitoring events at SWMU 73 delineating the extent of groundwater contaminant concentrations, there is no longer a need to monitor surface water. Groundwater concentrations adjacent to Charlie's Pond are below risk based levels.

A CMS was completed in 2011 to evaluate remedial alternatives for soil and groundwater (Tetra Tech, 2011c). Based on evaluations completed as part of this study, excavation and removal of contaminated

surface soil, and LUCs and LTM of groundwater were chosen as the recommended remedial alternatives. SCDHEC commented that a better discussion about the location of the septic tank needed to be provided, along with evidence to support the rationale that there may be an upgradient source. The Department also questioned whether an investigation of another source had been conducted since (at the time of the completion of the 2011 CMS) the septic tank had not been located. SCDHEC also commented that the SWMU boundary may need to be modified. None of the corrective measures identified in the conditionally approved 2011 CMS were implemented pending completion of the required additional data collection.

A round of groundwater samples was collected in 2012. Lead was detected in four monitoring wells at concentrations less than the drinking water screening criterion. Arsenic was detected in three monitoring wells, but at concentrations greater than the MCL in only two of the monitoring wells (TEC-BSC Joint Venture, 2013).

Based on comments received from SCDHEC on the conditionally approved 2011 CMS, a CMS Work Plan was developed to describe the plan for collecting additional data (Tetra Tech, 2016). During the 2016 CMS Investigation, one permanent groundwater monitoring well was installed and a round of groundwater samples was collected from all permanent monitoring wells at SWMU 73 to better define the groundwater plume and to evaluate groundwater contamination. Also, one soil sample was collected at the location of the RFI chromium exceedance for analysis of total and hexavalent chromium, pH, and oxidation-reduction potential (ORP) to determine if hexavalent chromium is present in the soil.

The underground septic tank was discovered in 2016 during utility work, and was located during the 2016 CMS Investigation. An intrusive investigation was conducted as part of the 2016 CMS to locate and determine the approximate depth and size of the underground septic tank. Based on the results of the intrusive investigation, the septic tank was determined to be approximately 4 feet by 8 feet long, and the depth to the top of the septic tank ranged from approximately 10 to 14 inches below ground surface (bgs). No piping associated with the septic tank was located. Additionally, four soil samples were collected near the septic tank, and one temporary groundwater monitoring well was also installed in a soil boring adjacent to and just downgradient of the septic tank.

Semi-volatile organic compounds (SVOCs), pesticides, and metals were detected in soil samples. Benzo(a)pyrene and arsenic were the only contaminants detected at concentrations which exceeded project action levels (PALs) based on a residential scenario. Benzo(a)pyrene was detected in two surface soil samples located upgradient of the septic tank at levels only slightly greater than the PAL and the facility background concentration. Arsenic was detected in two subsurface soil samples collected adjacent to the septic tank at levels slightly greater than the facility background concentration and greater than the PAL. Additionally, one surface soil sample was collected at the location of the RFI chromium exceedance to determine if hexavalent chromium was present. Hexavalent chromium was detected in this surface soil sample at a concentration greater than the PAL. Soil sample locations are presented on **Figure 2**.

Several metals were detected in groundwater samples collected at SWMU 73. Groundwater samples were collected in 2011, 2012, and 2016 from permanent monitoring wells. Arsenic concentrations exceeded the PAL during all three rounds of groundwater sampling. Additionally, arsenic concentrations exceeded the PAL at the temporary monitoring well installed near the septic tank. Iron and manganese exceeded the PAL in only one monitoring well each, and only in the groundwater sample collected in 2016 from these monitoring wells. Monitoring well locations are shown on **Figure 3**.

Summary of SWMU Risks

The human health risk screening evaluation (HHRSE) for soil at SWMU 73 was initially conducted as part of the RFI process and concluded that the total cancer risk estimates for residential exposures to soil exceeded risk management benchmarks, and that chromium was the major contributor. The HHRSE was updated as part of the 2016 CMS Investigation (Tetra Tech, 2017a) to include the new soil sample results and to evaluate groundwater. The HHRSE was also updated because new United States Environmental Protection Agency (USEPA) default exposure assumptions (used to estimate risks) for some exposure factors had been published, toxicity criteria for some chemicals had been updated, and the USEPA regional screening levels (RSLs) had been updated since the RFI report (Tetra Tech, 2011b) was

completed. Additionally, the Basewide Facility Background (background) concentrations were updated in 2017 (Tetra Tech, 2017b).

The surface and subsurface soil cancer risks assume a hypothetical future resident is exposed to chemicals of potential concern (COPCs) in surface and subsurface soil, and the cancer risks for exposure to subsurface soil at SWMU 73 exceeded the target risk management level of 1 X 10^{-5}. The hazard index (HI) for future residential exposure to surface soil and subsurface soil are less than the risk management benchmark of 1 (i.e., unacceptable non-cancer risks are not anticipated). Arsenic was identified as a COC in soil. Total chromium and hexavalent chromium were evaluated as COPCs in the risk assessment and cancer risks for exposures to surface soil would only exceed acceptable levels if chromium is assumed to be present entirely as hexavalent chromium. Speciation performed on one sample suggests this is not the case, and the cancer risks from exposures to surface soils are within acceptable levels; therefore, neither were retained as a COC.

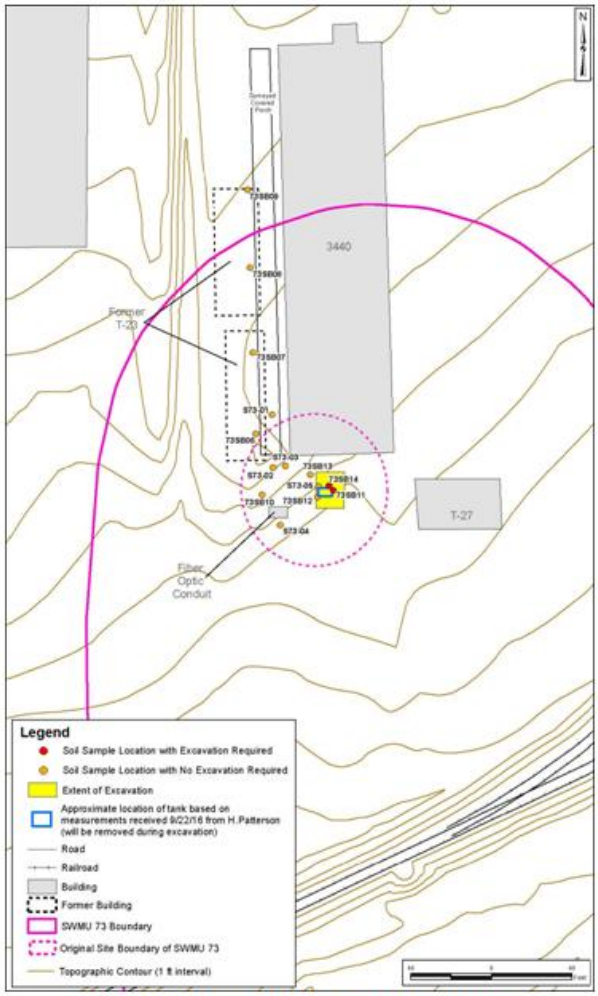


Figure 2. SWMU 73 (FL073) Site Map and Soil Excavation Area

Only the 2016 analytical results were used in the groundwater evaluation since they are more representative of current conditions at SWMU 73. Cancer risks and hazard indices assume groundwater is used as a residential (domestic) water source at SWMU 73. The cancer risks for a future resident exposed to groundwater at SWMU 73 exceeded the target risk management level of 1 X 10^{-5} and the HI for residential exposure to groundwater also exceeded the risk management benchmark of 1. Arsenic and iron were identified as COCs in groundwater.

Because cancer risks for exposures to subsurface soil and groundwater exceed acceptable levels, chemicals of concern (COCs) were identified and MCSs for soil and groundwater COCs were developed. The MCSs correspond to cancer risk levels for USEPA's target risk range of 10^{-4} to 10^{-6} and a hazard quotient of 1; therefore, MCSs were only calculated for analytes whose risk level exceeded the USEPA target levels. The recommended MCSs are based on the target risk management levels of 1 X 10^{-5} or an HI of 1.

Proposed Corrective Action

Soil Alternative 3 – Excavation and Off-Site Disposal

Soil Alternative 3 is the corrective measure selected to address contaminated subsurface soil at SWMU 73 in the CMS Report (Tetra Tech, 2017a). Soil Alternative 3 includes the excavation, removal and off-site disposal of contaminated soil and the septic tank to meet the MCS. The soil is expected to be non-hazardous. Additionally, in order to verify the existence or absence of piping associated with the septic tank, an intrusive investigation will occur during excavation of the tank. A discussion of this additional investigation will be described in the Corrective Measures Implementation Work Plan. Prior to excavation, the surface would be cleared. The estimated limits of the excavation area are shown on **Figure 2.** The maximum depth of the excavation is expected to be to the water table, or 4 feet bgs. Confirmation samples would be collected on each wall and the bottom of the excavation to confirm that the MCS has been met.

Approximately 60 cubic yards of soil would be excavated at SWMU 73 and disposed off-site. After excavation and disposal, the area would be graded, restored, and reseeded with grass.

Groundwater Alternative 3 – *In Situ* Chemical Oxidation, MNA, and LUCs

Groundwater Alternative 3 was developed as an active remedial alternative combining *in situ* chemical oxidation using oxygen release compound ORC Advanced in the source area, and MNA for the rest of the plume. The ORC treatment would create oxidizing conditions which allow for the precipitation of iron and arsenic. A large portion of the arsenic mass would be immobilized and would reduce the load of arsenic to be removed by natural processes. The balance of the arsenic would be remediated by natural attenuation.

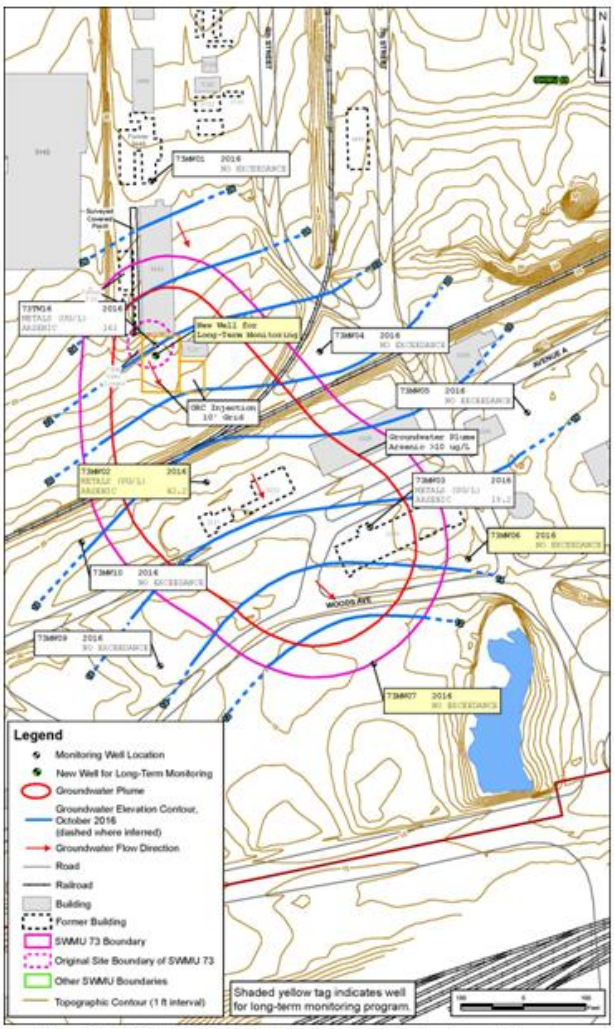


Figure 3. SWMU 73 (FL073) Site Map and Groundwater Remediation Area

Prior to design, a monitoring well would be installed in the source area so that arsenic and total organic carbon (TOC) concentrations, and geochemical parameters (such as pH and ORP) can be confirmed. Bench and pilot studies may be performed before the full-scale design is implemented to verify the spacing of injection points, and to confirm pH adjustment requirements and ORC dosages. ORC Advanced would be injected into the source area using direct push technology (DPT). Based on existing data, each boring would be advanced to a depth of approximately 15 feet bgs, and the ORC slurry would be injected from that depth up to the water table at approximately 4 feet bgs. Because the subsurface soil is fine-grained, a spacing of 10 feet is assumed. Based on the assumed area of the source, 99 borings would be required, and 230 pounds of ORC Advanced with 65 gallons of water per boring is assumed. The injection dosing would be finalized in the Corrective Measures Implementation Work Plan. The ORC would release oxygen for approximately 12 months.

A performance monitoring program would be implemented to document the remedy effectiveness and to monitor progress of the corrective measures. Performance monitoring would include a baseline sampling event prior to injections, and quarterly monitoring for four quarters post-injection. If elevated arsenic persists, an additional injection would be performed. Following demonstration that contaminant levels had been reduced in the source area, RA-O monitoring of the balance of the plume to monitor MNA would continue annually until three consecutive rounds of sampling with concentrations less than MCSs are achieved. The new well and three downgradient wells (73MW02, 73MW06, and 73MW07) would be sampled. Performance and RA-O monitoring parameters would include arsenic and iron, as well as MNA parameters (ORP, ferrous iron, dissolved oxygen, sulfate, and sulfide) at wells within the plume to monitor groundwater geochemistry and verify that conditions are appropriate for natural attenuation.

Groundwater Alternative 3 would include the implementation of LUCs to restrict the use of site groundwater.

A corrective measures implementation report would be prepared after completion of the injections to document the remedy effectiveness. Annual RA-O reports would include a summary of monitoring results, an evaluation of arsenic and iron concentration trends, data evaluation, conclusions, and recommendations. The annual RA-O report would also document annual LUC inspections and verify continued LUC effectiveness.

LUCs: The proposed remedies include LUCs for soil and groundwater. LUCs will be implemented to prevent residential land use, to require appropriate controls during intrusive work at the site, and to restrict groundwater use. The specific LUCs include:

- Logging the LUC boundaries (inclusive of all polygon coordinates) and use restrictions (to prevent residential land use, to require appropriate controls during intrusive work at the site, and to restrict groundwater use) into the Base geographic information system to officially identify the site as being impacted by groundwater contamination and to prompt RPM reviews of any proposed disturbance or new use of the site. The review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If land disturbing activities impact an ERP site, the RPM will contact SCDHEC for notification as specified in the RCRA Permit.
- Annual LUC inspections to verify that no construction or well installation has occurred at the site without proper review initiated with the Civil Engineer Squadron dig permit process.
- At a minimum, an annual report will be submitted summarizing the field events that took place at the site during that year. In some cases, it may be an inspection letter/report. In other cases, it will also include the reporting of groundwater samples collected. The report will also discuss if there has been a change in land use during the reporting period.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 73.

SWMU 82: Old M-79 Grenade Range
Potential Contaminants Investigated: Munitions and explosives of concern (MEC), munitions debris (MD), and potential munitions constituents (MC)
Media: Surface and subsurface soil
Proposed Remedy: Soil: Surficial Debris Removal and Existing Cover; Land Use Controls (LUCs)

Site Background

The SWMU 82 MRS includes cleared land surrounded by forest and wetlands (**Figure 2**). With the exception of the adjacent active EOD OB/OD range, there are no buildings or structures associated with this MRS. The open MRS terrain is managed by clearing and seeding the area to provide food for the resident deer population. According to the Installation Development Plan for JBC Weapons, the future land use for the SWMU 82 area is industrial. SWMU 82 was used by Marine Corps Security and EOD Mobile Unit 6 as a former firing range for practice rounds from the Model (M)-79 and later from the M-203 grenade launchers and for other training exercises. During training and qualification exercises, M-781 40-millimeter (mm) practice grenades were fired at targets, including old automobiles. This range was active in approximately 1975 and closed in 1992. Fragments of inert rounds, broken bits of blue plastic, and pieces of metal debris are scattered throughout the MRS and one automobile target was identified at the former range (TtNUS, 2009).

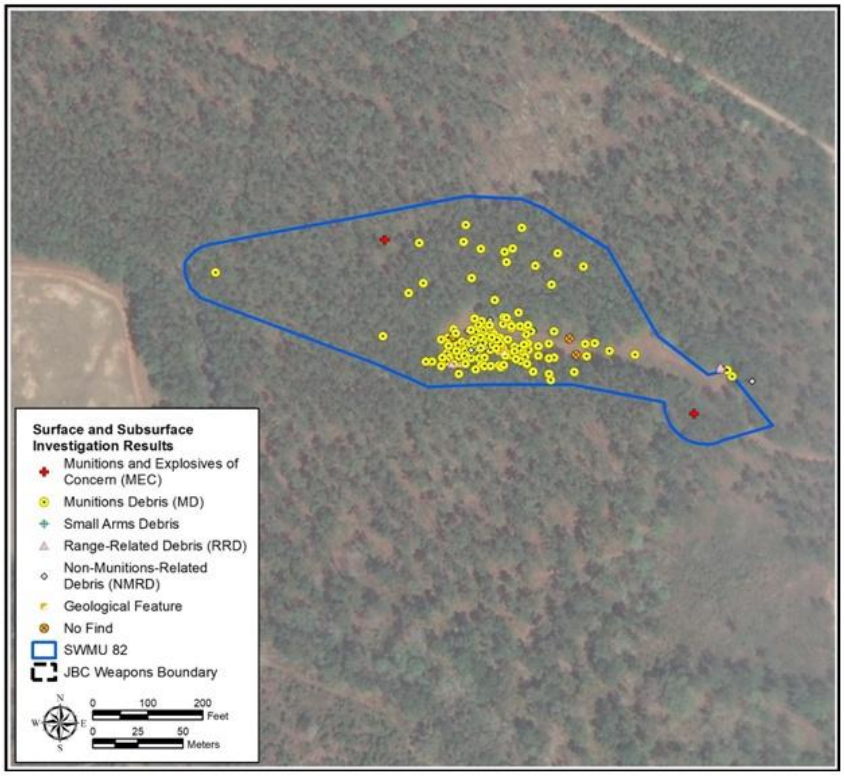


Figure 2. SWMU 82 (XE001) Site Map

Site Investigations

As documented in the RI/FS Report (URS, 2016), a comprehensive MMRP surface clearance was completed throughout the MRS boundaries identified by a previous Site Inspection (SI) (TtNUS, 2009). Two MEC items (155mm projectiles) were removed from SWMU 82 during the SI (TtNUS, 2009). No MEC was identified within these former SWMU 82 boundaries during the RI, but significant quantities of MD including abundant 40mm debris and some indeterminate fragments were removed (URS, 2016). Based on observations of MEC and MD outside of the MRS boundaries, additional RI visual survey activities were completed to the north and west of the former SWMU 82 boundaries using MEC and anomaly avoidance procedures. Two potential MEC items (an M381 40mm grenade and a 5-inch projectile) were identified during these additional visual survey activities. Due to the location of these items outside the boundaries of the MRS, the items were appropriately characterized and disposed by JBC EOD personnel.

Four RI surface soil samples were collected at SWMU 82 to delineate low level explosives constituent concentrations that were observed in two previously collected SI samples (TtNUS, 2009). Two additional surface soil samples were co-located with the potential MEC items that were identified outside of the MRS boundaries during RI visual survey activities. All RI sample results were non-detect for explosives constituents at SWMU 82. Since all RI MC sampling results were non-detect, the nature and extent of potential MC at SWMU 82 was defined and no additional MC investigation was warranted. RI human

health and ecological risk assessments further evaluated the combined SI (TtNUS, 2009) and RI (URS, 2016) MC sample results for SWMU 82. No chemicals of potential concern were identified at SWMU 82 for human health or ecological receptors. Screening criteria for human health were based on residential land use. Therefore, no unacceptable human health or ecological risks were identified at the MRS for site workers, recreational users/trespassers, hypothetical future residents, or ecological receptors exposed to SWMU 82 soil.

No additional MEC or MC investigation is currently warranted at SWMU 82 based on its historical use as a former grenade range. However, because MEC and MD were identified outside the SI-established MRS boundaries, expansion of the MRS was recommended in the RI (URS, 2016). **Figure 2** shows the expanded boundaries of the SWMU 82 MRS. The boundaries were expanded to encompass all MEC and MD identified outside of the MRS boundaries during RI visual survey activities. The expansion of SWMU 82 increased the MRS acreage from approximately 1.5 to 5 acres (URS, 2016). The RI/FS identified no significant quantities of non-munitions-related debris (NMRD) at SWMU 82.

Summary of SWMU Risks

As documented in the RI/FS Report (URS, 2016), a comprehensive MMRP surface clearance was completed throughout the MRS boundaries identified by a previous Site Inspection (SI) (TtNUS, 2009). Two MEC items (155mm projectiles) were removed from SWMU 82 during the SI (TtNUS, 2009). No MEC was identified within these former SWMU 82 boundaries during the RI, but significant quantities of MD including abundant 40mm debris and some indeterminate fragments were removed (URS, 2016). Based on observations of MEC and MD outside of the MRS boundaries, additional RI visual survey activities were completed to the north and west of the former SWMU 82 boundaries using MEC and anomaly avoidance procedures. Two potential MEC items (an M381 40mm grenade and a 5-inch projectile) were identified during these additional visual survey activities. Due to the location of these items outside the boundaries of the MRS, the items were appropriately characterized and disposed by JBC EOD personnel. Four RI surface soil samples were collected to delineate low level explosives constituent concentrations that were observed in two previously collected SI samples (TtNUS, 2009). Two additional surface soil samples were co-located with the potential MEC items that were identified outside of the MRS boundaries during RI visual survey activities. All RI sample results were non-detect for explosives constituents at SWMU 82. Since all RI MC sampling results were non-detect, the nature and extent of potential MC at SWMU 82 was defined and no additional MC investigation was warranted. RI human health and ecological risk assessments further evaluated the combined SI (TtNUS, 2009) and RI (URS, 2016) MC sample results for SWMU 82. No chemicals of potential concern were identified at SWMU 82 for human health or ecological receptors. Screening criteria for human health were based on residential land use. Therefore, no unacceptable human health or ecological risks were identified at the MRS for site workers, recreational users/trespassers, hypothetical future residents, or ecological receptors exposed to the soil. The RI/FS identified no significant quantities of non-munitions-related debris (NMRD) at SWMU 82.

Proposed Corrective Action

The remedial alternative selected as part of the FS to address potential MEC at SWMU 82 is MEC Alternative 2: LUCs and Construction Support.

Based on information currently available, the USAF believes that MEC Alternative 2 (LUCs and Construction Support) best meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The USAF expects that the preferred Alternative of LUCs and Construction Support will satisfy both the statutory requirements of CERCLA (i.e., protection of human health and compliance with ARARs) and the existing RCRA permit.

MEC Alternative 2 (LUCs and Construction Support) includes developing and maintaining LUCs for SWMU 82. A LUC Implementation Plan (LUCIP) would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. The LUCIP documents the requirements for implementation, maintenance, and inspection of LUCs. LUCs would consist of institutional and engineering controls.

Institutional controls would include administrative mechanisms such as restrictions to prevent future construction activities at SWMU 82 unless proper planning, permissions, and safety considerations are made. In addition, MEC Alternative 2 (LUCs and Construction Support) would require construction support for any future construction activities or other intrusive work completed within the MRS. Any future intrusive activities at SWMU 82 (XE001) could require an Explosives Safety Submission (ESS). LUCs are documented in the Installation Development Plan. The Base Remedial Project Manager (RPM) works with the 628 Civil Engineer Squadron Base Community Planner (Base Community Planner) to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities). Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb SWMU 82. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If the planned activity constitutes a change in land use impacting SWMU 82, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections (e.g., construction support) are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Engineering controls would consist of installing signs or maintaining existing signs to warn site receptors of the potential surface and subsurface MEC risks remaining at the MRS (note that existing signs are in place at SWMU 82 associated with the adjacent active EOD OB/OD range). Signs would be installed/maintained at access roads and around the MRS perimeter. Installation of signs, if necessary, would be completed by construction workers, supported by Unexploded Ordnance (UXO) personnel providing anomaly avoidance and would consist of a minimum of one UXO Technician II. The probability of encountering MEC along the perimeter of the MRS during sign installation is considered low, so an ESS is not anticipated to be required. Controls would be maintained, as needed, through future property transfers or until potential MEC hazards have been addressed.

Future decisions about land use would drive long term management (LTM) requirements. For example, if land use at SWMU 82 changed from an undeveloped natural resources management area to another use (unlikely for SWMU 82), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 82.

SWMU 81: Southside Explosive Ordnance Disposal Training Area
Potential Contaminants Investigated: Munitions and explosives of concern (MEC), munitions debris (MD), munitions constituents (MC), and non-munitions-related debris (NMRD)
Media: Surface and subsurface soil
Proposed Remedy: Soil: Surficial Debris Removal and Existing Cover; Land Use Controls (LUCs)

Site Background

SWMU 81 consists of approximately 5 acres in the southern portion of JBC Weapons. The MRS consists of two disconnected areas (Area A [west portion] and Area B [east portion]) separated by Torpedo Road and an active munitions storage area staging lot.

The MRS was used between 1965 and 1975 for EOD proficiency training by NWS Charleston EOD personnel. Personnel were trained in the use of unique tool sets and procedures to locate, identify, render safe, and dispose of unexploded ordnance (UXO). Training aids were inert (without explosive) versions of munitions items (e.g., 50 Series Naval mines, Mark [Mk] 80 Series aerial bombs, torpedoes, and various inert projectiles). In addition to inert training aids, stockpiles of thermally treated metallic debris (i.e., slag piles) were identified in the eastern portion (Area B) of the MRS. These materials were reportedly associated with historical open burn/open detonation (OB/OD) activities known to have been conducted in the area.

Site Investigations

MEC was not identified at SWMU 81 during the MMRP IRA or RI fieldwork. However, numerous MD items (primarily EOD training devices/inert practice munitions) and piles of slag, including MD and RRD, were removed from the surface during the IRA. Although surface MD was removed during the IRA (URS, 2015), a potential for encountering subsurface MEC remains at SWMU 81, especially in proximity to the former slag piles (**Figure 2**).

A total of 21 surface soil samples were collected during the RI for MC metals and/or explosives analyses. These samples were collected to delineate potentially elevated MC concentrations observed in previous Comprehensive Site Evaluation (CSE) Phase II samples (URS, 2013), and to assess any potential contaminants associated with the former slag piles removed from the MRS surface during the IRA (URS, 2015).

All sample results were non-detect for explosives constituents. Human health and ecological risk assessments evaluated the combined CSE Phase II (URS, 2013) and RI metals data. Lead was the only MC analyte retained for further evaluation during the human health risk assessment. No unacceptable risks were identified for site workers, recreational users/trespassers, or hypothetical future residents (adult and child) exposed to lead in soil.

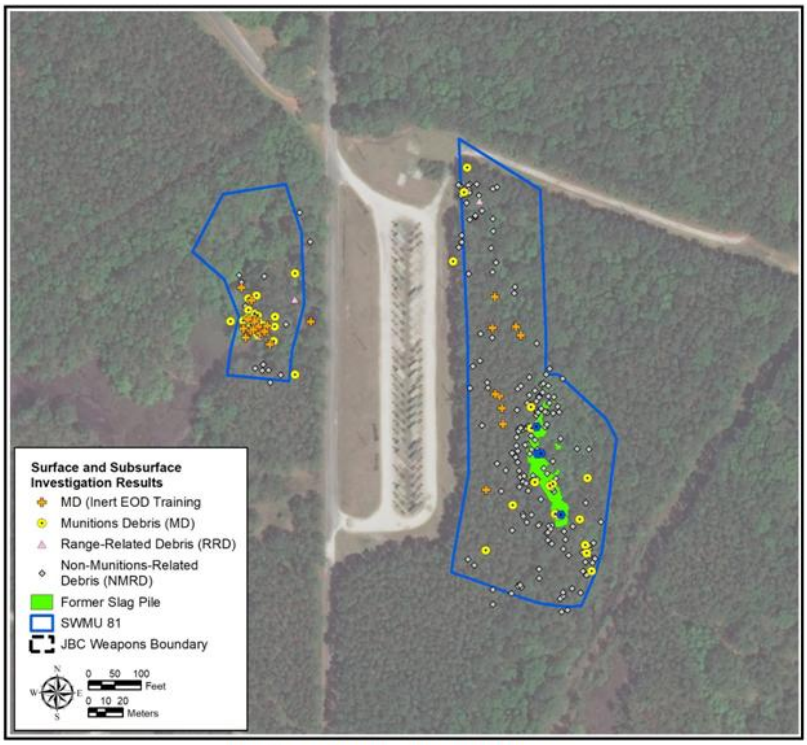


Figure 2. SWMU 81 (ED17178B) Site Map

During the ecological risk assessment, exposure concentrations of copper, lead, and zinc were evaluated for potential bird (i.e., the Carolina wren)

exposure. A small and localized distribution of slightly elevated metals concentrations, combined with the relatively small Carolina wren population in the area, resulted in the determination that no unacceptable risks were identified for ecological receptors.

The RI/FS also identified a relatively significant quantity of NMRD including large and/or deeply embedded construction debris and scrap metal that had been left in place at SWMU 81. These materials did not appear to be significant sources of chemical contaminants. More than 100 large and/or deeply embedded NMRD items were subjected to the material potentially presenting an explosive hazard (MPPEH) inspection process, documented by global positioning system, and left in place during the IRA (URS, 2015) surface clearance due to access limitations, safety considerations, and to minimize disturbance to the environment. Removal would have required the use of heavy equipment and would have resulted in extensive damage to the natural environment, as discussed in the RI/FS Report (URS, 2016).

Summary of SWMU Risks

MEC was not identified at SWMU 81 during the MMRP IRA or RI fieldwork. However, numerous MD items (primarily EOD training devices/inert practice munitions) and piles of slag, including MD and RRD, were removed from the surface during the IRA. Although surface MD was removed during the IRA (URS, 2015), a potential for encountering subsurface MEC remains at SWMU 81, especially in proximity to the former slag piles (**Figure 2**).

A total of 21 surface soil samples were collected during the RI for MC metals and/or explosives analyses. These samples were collected to delineate potentially elevated MC concentrations observed in previous Comprehensive Site Evaluation (CSE) Phase II samples (URS, 2013), and to assess any potential contaminants associated with the former slag piles removed from the MRS surface during the IRA (URS, 2015).

All sample results were non-detect for explosives constituents. Human health and ecological risk assessments evaluated the combined CSE Phase II (URS, 2013) and RI metals data. Lead was the only MC analyte retained for further evaluation during the human health risk assessment. No unacceptable risks were identified for site workers, recreational users/trespassers, or hypothetical future residents (adult and child) exposed to lead in soil.

During the ecological risk assessment, exposure concentrations of copper, lead, and zinc were evaluated for potential bird (i.e., the Carolina wren) exposure. A small and localized distribution of slightly elevated metals concentrations, combined with the relatively small Carolina wren population in the area, resulted in the determination that no unacceptable risks were identified for ecological receptors.

The RI/FS also identified a relatively significant quantity of NMRD including large and/or deeply embedded construction debris and scrap metal that had been left in place at SWMU 81. These materials did not appear to be significant sources of chemical contaminants. More than 100 large and/or deeply embedded NMRD items were subjected to the material potentially presenting an explosive hazard (MPPEH) inspection process, documented by global positioning system, and left in place during the IRA (URS, 2015) surface clearance due to access limitations, safety considerations, and to minimize disturbance to the environment. Removal would have required the use of heavy equipment and would have resulted in extensive damage to the natural environment, as discussed in the RI/FS Report (URS, 2016).

Proposed Corrective Action

The remedial alternative selected as part of the FS to address potential MEC at SWMU 81 is MEC Alternative 2: LUCs and Construction Support.

Based on information currently available, the USAF believes that MEC Alternative 2 (LUCs and Construction Support) best meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The USAF expects that the preferred Alternative of LUCs

and Construction Support will satisfy both the statutory requirements of CERCLA (i.e., protection of human health and compliance with ARARs) and the existing RCRA permit.

MEC Alternative 2 (LUCs and Construction Support) includes developing and maintaining LUCs for SWMU 81. A LUC Implementation Plan (LUCIP) would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. The LUCIP documents the requirements for implementation, maintenance, and inspection of LUCs. LUCs would consist of institutional and engineering controls.

Institutional controls would include administrative mechanisms such as restrictions to prevent future construction activities at SWMU 81 unless proper planning, permissions, and safety considerations are made. In addition, MEC Alternative 2 (LUCs and Construction Support) would require construction support for any future construction activities or other intrusive work completed within the MRS. Any future intrusive activities at SWMU 81 could require an Explosives Safety Submission (ESS). LUCs are documented in the Installation Development Plan. The Base Remedial Project Manager (RPM) works with the 628 Civil Engineer Squadron Base Community Planner (Base Community Planner) to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities).

Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb SWMU 81. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If the planned activity constitutes a change in land use impacting SWMU 81, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections (e.g., construction support) are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Engineering controls would consist of installing signs or maintaining existing signs to warn site receptors of the potential surface and subsurface MEC risks remaining at the MRS (note that existing signs are in place at SWMU 81 associated with the adjacent active EOD OB/OD range). Signs would be installed/maintained at access roads and around the MRS perimeter. Installation of signs, if necessary, would be completed by construction workers, supported by Unexploded Ordnance (UXO) personnel providing anomaly avoidance and would consist of a minimum of one UXO Technician II. The probability of encountering MEC along the perimeter of the MRS during sign installation is considered low, so an ESS is not anticipated to be required. Controls would be maintained, as needed, through future property transfers or until potential MEC hazards have been addressed.

Future decisions about land use would drive long term management (LTM) requirements. For example, if land use at SWMU 81 changed from an undeveloped natural resources management area to another use (unlikely for SWMU 81), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

The remedial alternative selected as part of the FS to address potential Non Munition Related Debris (NMRD) at SWMU 81 is MEC Alternative 2: LUCs and Construction Support.

Based on information currently available, the USAF believes that NMRD Alternative 2 (LUCs) best meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria.

NMRD Alternative 2 (LUCs) includes developing and maintaining LUCs for SWMU 81 based on NMRD left in place. A LUCIP would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. LUCs would consist of institutional controls, including administrative

mechanisms such as restrictions to prevent unauthorized intrusive activities within the MRS. Controls would be maintained, as needed, through future property transfers or until NMRD concerns have been addressed. LUCs are documented in the Installation Development Plan. The Base RPM works with the Base Community Planner to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities).

Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb SWMU 81. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If the planned activity constitutes a change in land use impacting SWMU 81, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Future decisions about land use would drive LTM requirements. For example, if land use changed from an undeveloped active munitions storage area to residential or some other use (unlikely for SWMU 81), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 81.

SWMU 79: South Annex Marsh Dumping Area
Potential Contaminants Investigated: Munitions and explosives of concern (MEC), munitions debris (MD), and potential munitions constituents (MC), and non-munitions-related debris (NMRD)
Media: Surface and subsurface soil
Proposed Remedy: Soil: Surficial Debris Removal and Existing Cover; Land Use Controls (LUCs)

Site Background

SWMU 79 consists of approximately 4 acres in the southern portion of JBC Weapons. Historical information suggested that explosives waste from munitions loading and manufacturing operations, including operations at what is now SWMU 20 (an adjacent MRS), were potentially disposed of at SWMU 79. Historical drawings from 1955 through 1958 noted that the area was historically labeled as a Burning Ground. Tidal wetlands and drainage areas associated with Goose Creek are present throughout most of SWMU 79. These areas are inundated by tidal waters except during low tides. A former burn area, a former road that led to the burn area, and an abandoned railroad bed have been documented at the MRS during previous field investigations. The SWMU 79 terrain is an undeveloped marsh that is not easily accessible to human receptors (**Figure 2**). The Installation Development Plan does not present any designated future land use for SWMU 79; the area within the site boundaries is designated as a water area because it floods at high tide. Thus, no changes in current land use are anticipated.

Site Investigations

No evidence of MEC, MD, range-related debris, or former burning practices was observed at SWMU 79 during the MMRP IRA or RI fieldwork. However, an abundance of NMRD was identified during the MMRP fieldwork (**Figure 2**). The potential burn area previously identified at SWMU 79 was thoroughly investigated by visual survey, surface clearance, and subsurface investigation of target anomalies identified with subsurface geophysical instrumentation. Any visual evidence of burning activities has been removed or obscured over time by the dense marsh vegetation and water-saturated sediments (i.e., SWMU 79 is inundated by tidal waters for most of each day). The RI/FS concluded that no additional MEC investigation activities were warranted at SWMU 79.

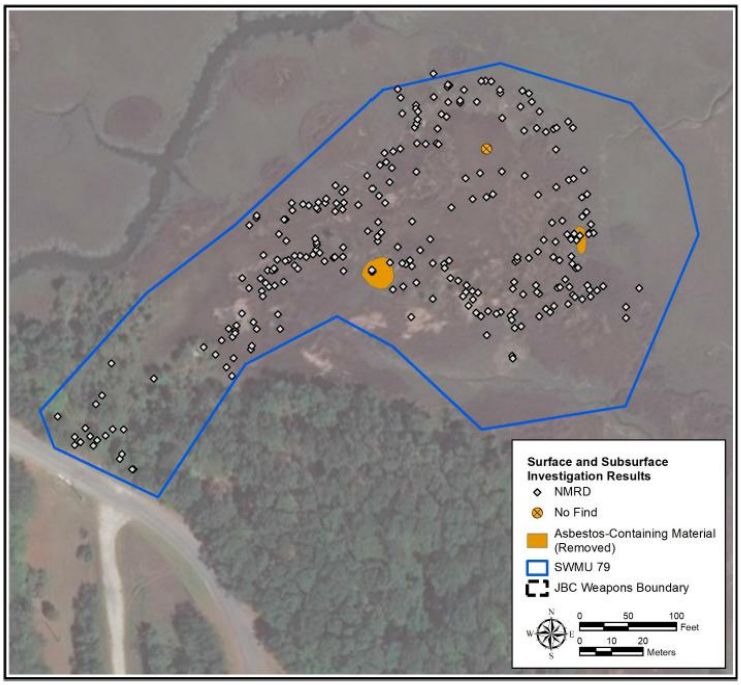


Figure 2. SWMU 79 (MU17175A) Site Map

The only media of concern for MC sampling at SWMU 79 was sediment. Based on previous data, target metals, polycyclic aromatic hydrocarbons (PAHs), and one polychlorinated biphenyl (PCB) (Aroclor 1260) were investigated in sediment during the RI. No evidence of MEC, MD, or munitions related activities were identified during the IRA or RI activities at SWMU 79; therefore, the chemical constituents addressed were not considered to be munitions-related. Sediment sampling results in proximity to the presumed former burn area identified elevated levels of potential contaminants that may be indicative of former burning activities. However, these results did not indicate that the contaminants were munitions-related. Elevated levels of PAHs were detected above preliminary human health (i.e., residential) and ecological screening criteria and metals results in several samples slightly exceeded ecological screening criteria. Concentrations were typically greater in proximity to the location previously identified as the former burn area (i.e., near the center of the MRS).

Human health and ecological risk assessments evaluated the combined Site Inspection (SI) (TtNUS, 2010) and RI sediment sample data. The chemicals of potential concern (PAHs and the PCB Aroclor 1260) identified for SWMU 79 are not considered to be MC, although PAHs may indicate that former burning activities were conducted at the MRS. Current and future land use scenarios were evaluated in the human health risk assessment, including current and future recreational user/trespasser, hypothetical future resident, and future construction worker. Human health risk assessment results indicated that the inaccessible terrain at SWMU 79 limited the potential for significant human exposure. No unacceptable risks were identified for the receptors evaluated, including the hypothetical future resident.

Summary of SWMU Risks

No unacceptable risks were identified for the chemicals of potential ecological concern that were identified at the MRS (i.e., cadmium, copper, lead, zinc, PAHs, and Aroclor 1260). In addition, the slightly elevated PAHs, Aroclor 1260, and metals concentrations observed at SWMU 79 were not considered munitions related. Based on the calculated low risk potential for human health and the environment and the general inaccessibility to all feasible direct contact human health exposures, no further actions regarding SWMU 79 sediment were warranted.

The RI/FS concluded that a significant quantity of NMRD (e.g., scrap metal, tires, construction debris, and railroad debris) had been left in place at SWMU 79. These materials did not appear to be significant sources of chemical contaminants. More than 100 large and/or deeply embedded NMRD items were inspected, documented by global positioning system, and left in place during the IRA (URS, 2015) due to access limitations, safety considerations, and to minimize disturbance to the wetland environment. Removal would have required the use of heavy equipment and would have resulted in extensive damage to the sensitive marsh vegetation and wetland ecosystem (URS, 2016).

Proposed Corrective Action

The remedial alternative selected as part of the FS to address potential NMRD at SWMU 79 is Alternative 2: LUCs.

NMRD Alternative 2 includes developing and maintaining LUCs for SWMU 79. A LUC Implementation Plan (LUCIP) would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. LUCs would consist of institutional controls, including administrative mechanisms such as restrictions to prevent unauthorized intrusive activities within the MRS. Controls would be maintained, as needed, through future property transfers or until NMRD concerns have been addressed. LUCs are documented in the Installation Development Plan. The Base Remedial Project Manager (RPM) works with the 628 Civil Engineer Squadron Based Community Planner (Base Community Planner) to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities). The cost estimate for this alternative includes capital costs associated with establishing LUCs (i.e., administrative tasks), as well as O&M costs.

Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb SWMU 79. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If the planned activity constitutes a change in land use impacting SWMU 79, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Annual land use control inspections would be completed. Because the NMRD identified and left in place at this site is not considered to be a significant human health hazard, signs are not warranted as part of the

LUC remedy at SWMU 79. Since Alternative 2 is a non-invasive remedy, major impacts on marsh vegetation, associated wildlife/aquatic life, and loss of biodiversity will be avoided.

Future decisions about land use would drive long term management (LTM) requirements. For example, if land use changed from undeveloped to residential or some other use (unlikely for SWMU 79 based on its wetland terrain), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 79.

AOC L: Southside Borrow Pit
Potential Contaminants Investigated: Munitions and explosives of concern (MEC), munitions debris (MD), and potential munitions constituents (MC), and non-munitions-related debris (NMRD)
Media: Surface and subsurface soil
Proposed Remedy: Soil: Surficial Debris Removal and Existing Cover; Land Use Controls (LUCs)

Site Background

AOC L occupies approximately 1 acre in the Southside portion of JBC Weapons, north of Goose Creek and west of Torpedo Road, adjacent to a former borrow pit. An active, open-air munitions storage facility and Solid Waste Management Unit (SWMU) 81 are located directly east of AOC L.

AOC L was identified during a review of aerial photographs from the 1960s as an area that had been cleared by earthwork. Following further review and site reconnaissance during a site inspection (SI), the area was initially identified as a former borrow pit. However, the actual AOC L boundary is located to the east of the former borrow pit. A stockpile of thermally treated MD was identified on the ground surface during the SI (Tetra Tech NUS, Inc. [TtNUS], 2010). AOC L was apparently used for disposal of thermally treated MD from open burn/open detonation (OB/OD) operations likely conducted elsewhere at the installation. No MEC has been identified at the MRS. AOC L consists of undeveloped marsh and woodland terrain. There are no buildings or structures associated with the MRS; however, there are wetlands within and adjacent to the MRS. Special access permissions are required to enter this secure portion of JBC Weapons due to the active munitions storage facilities and operations in the area. AOC L is currently unused and no changes in current land use are anticipated. According to the Installation Development Plan for JBC Weapons, the long-term planned used for this site is to maintain it for use as an open space/buffer area.

Site Investigations

No MEC has been identified at AOC L and all visible MD and RRD were removed from the surface of the MRS during an IRA surface clearance (URS, 2015). The removal of a large pile of debris was also completed during the surface clearance fieldwork. The removed pile extended approximately 2.5 to 3 feet above the surrounding ground surface, and measured approximately 50 feet long by 35 feet wide. The debris pile was removed to approximately 1.0 foot below ground surface (bgs). The remaining buried extent of the former debris pile was characterized horizontally and vertically using magnetometers and test holes dug adjacent to metallic anomalies. The depth of remaining debris below the former pile ranged from approximately 0.7 to 1.0 foot below the excavated grade (or 1.7 to 2.0 feet bgs as compared to surrounding grade). Once the subsurface extent of the former debris pile area was fully characterized, the excavated areas were filled and the surface was regraded to match the surrounding terrain.

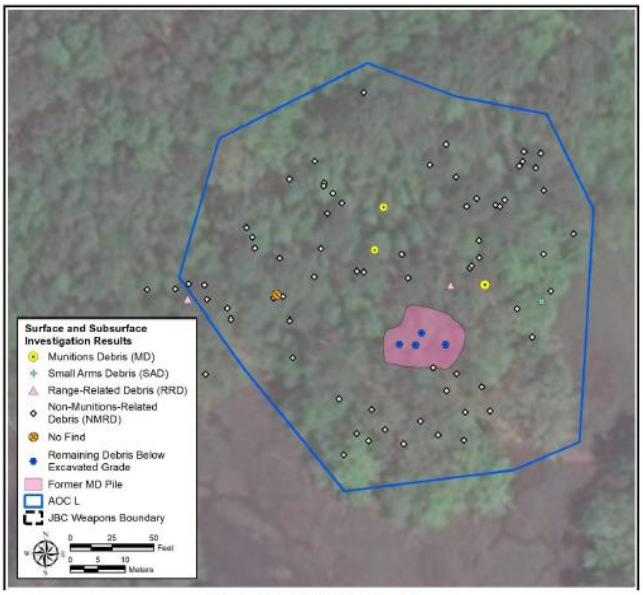


Figure 2. AOC L (XE007) Site Map

The debris removed from the piles included NMRD and more than 5,500 pounds of RRD and 1,500 pounds of MD. The debris identified as RRD consisted of ammunition shipping crates, cradles, and containers. The MD consisted of M1A2 grenade projection adapters, the screw-in head assemblies of M52A2 point detonating fuzes, 7.2-inch hedgehog inert filled rockets, and grenade actuating levers.

In addition to the surface clearance and debris pile removal activities at AOC L, a subsurface investigation of analog geophysical target anomalies was also completed during the RI. Of the 62 target anomalies investigated, one was identified as MD (a rifle grenade adapter), two were identified as RRD (empty

ammunition container and a munition container support), one was identified as small arms debris (link), and one location was documented as a no find. The remaining target anomaly locations (57 total) were characterized as NMRD (**Figure 2**)

The only media of concern for RI MC sampling at AOC L was soil. Ten surface soil samples were collected for explosives and MC metals analyses to further delineate potentially elevated concentrations observed in previously reported SI samples and to assess any potential contaminants associated with the former debris pile removed from the MRS during the IRA surface clearance (URS, 2015).

Summary of SWMU Risks

All sample results were non-detect for explosives constituents. Data from the SI and RI indicating positive detections of MC were evaluated in the human health and ecological risk evaluations included in the RI/FS report. No constituents of potential human health or ecological concern were identified. Screening criteria for human health were based on residential land use. Therefore, no unacceptable risks were identified for human health or ecological receptors.

Proposed Corrective Action

The remedial alternative selected as part of the FS to address potential MEC at AOC L is MEC Alternative 2: LUCs and Construction Support. Based on information currently available, the USAF believes that MEC Alternative 2 (LUCs and Construction Support) best meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The USAF expects that the preferred Alternative of LUCs and Construction Support will satisfy both the statutory requirements of CERCLA (i.e., protection of human health and compliance with ARARs) and the existing RCRA permit.

MEC Alternative 2 (LUCs and Construction Support) includes developing and maintaining LUCs for AOC L. A LUC Implementation Plan (LUCIP) would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. The LUCIP documents the requirements for implementation, maintenance, and inspection of LUCs. LUCs would consist of institutional and engineering controls.

Institutional controls would include administrative mechanisms such as restrictions to prevent future construction activities at AOC L unless proper planning, permissions, and safety considerations are made. In addition, MEC Alternative 2 (LUCs and Construction Support) would require construction support for any future construction activities or other intrusive work completed within the MRS. Any future intrusive activities at AOC L could require an Explosives Safety Submission (ESS). LUCs are documented in the Installation Development Plan. The Base Remedial Project Manager (RPM) works with the 628 Civil Engineer Squadron Base Community Planner (Base Community Planner) to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities).

Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb AOC L. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If the planned activity constitutes a change in land use impacting AOC L, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections (e.g., construction support) are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Engineering controls would consist of installing signs or maintaining existing signs to warn site receptors of the potential surface and subsurface MEC risks remaining at the MRS (note that existing signs are in place at AOC L associated with the adjacent active EOD OB/OD range). Signs would be installed/maintained at

access roads and around the MRS perimeter. Installation of signs, if necessary, would be completed by construction workers, supported by Unexploded Ordnance (UXO) personnel providing anomaly avoidance and would consist of a minimum of one UXO Technician II. The probability of encountering MEC along the perimeter of the MRS during sign installation is considered low, so an ESS is not anticipated to be required. Controls would be maintained, as needed, through future property transfers or until potential MEC hazards have been addressed.

Future decisions about land use would drive long term management (LTM) requirements. For example, if land use at AOC L changed from an undeveloped natural resources management area to another use (unlikely for AOC L), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

The remedial alternative selected as part of the FS to address potential NMRD at AOC L is Alternative 2: LUCs. Based on information currently available, the USAF believes that NMRD Alternative 2 (LUCs) best meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria.

NMRD Alternative 2 (LUCs) includes developing and maintaining LUCs for AOC L based on NMRD left in place. A LUCIP would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. LUCs would consist of institutional controls, including administrative mechanisms such as restrictions to prevent unauthorized intrusive activities within the MRS. Controls would be maintained, as needed, through future property transfers or until NMRD concerns have been addressed. LUCs are documented in the Installation Development Plan. The Base RPM works with the Base Community Planner to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities).

Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb AOC L. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If the planned activity constitutes a change in land use impacting AOC L, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Future decisions about land use would drive LTM requirements. For example, if land use changed from an undeveloped active munitions storage area to residential or some other use (unlikely for AOC L), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at AOC L.

AOC 22: Old South Annex Possible Munitions Disposal Area
Potential Contaminants Investigated: Munitions and explosives of concern (MEC), munitions debris (MD), and potential munitions constituents (MC)
Media: Soil, sediment, and groundwater
Proposed Remedy: No Further Investigation – LUCs

Site Background

SWMU 22, also known as the Old South Annex Possible Munitions Disposal Area MRS, occupies approximately 3 acres. Debris (i.e., building/construction material disposed along the marsh edge) was encountered in 1993 during construction of the Grace-Hopper Bridge, which is located north of SWMU 22. Information obtained from former installation personnel during previous studies indicated that munitions (including potential MEC) might have been disposed of at SWMU 22. However, the types, quantities, and periods of disposal were unknown and there were no specific reports of munitions or munitions-related items within the debris (Malcolm Pirnie, Inc., 2005). In addition, site-specific records indicating disposal of ordnance at SWMU 22 have not been identified (TtNUS, 2010).

Site Investigations

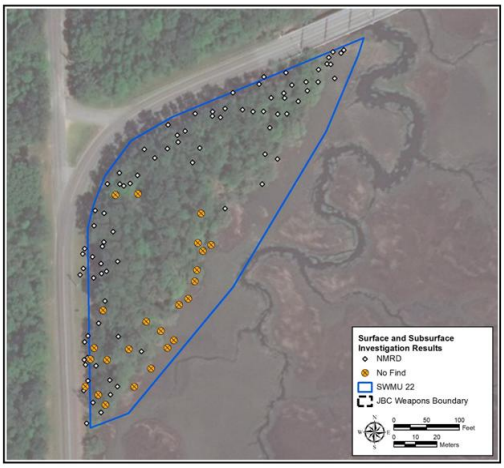


Figure 2. SWMU 22 (XE003) Site Map

The objective of the RI at SWMU 22 was to determine if the site had been impacted by MEC or MC and, if present, to delineate the nature and extent of munitions-related contamination, and to evaluate any associated risks to human health or the environment. A MEC visual survey, surface clearance, subsurface investigation, and MC sampling activities were all completed at SWMU 22 during the RI fieldwork.

No MEC, MD, range-related debris, evidence of former munitions use, or significant non-munitions-related debris (NMRD) was identified on the surface or in the subsurface of SWMU 22 during the RI fieldwork. MC sample results from SWMU 22 identified no MC risk in soil, sediment, or groundwater at the site. Human health and eco risk assessments presented in the RI Report (URS, 2016) further evaluated the combined Site Inspection (TtNUS, 2010) and RI MC sample results for SWMU 22.

Summary of SWMU Risks

No known or suspected MEC or physical evidence of former munitions use or disposal has been identified at SWMU 22. No constituents of potential concern were identified for human health or ecological receptors, including hypothetical future residents. Therefore, based on the results of the RI, MEC and MC exposures pathways are considered incomplete at SWMU 22.

Proposed Corrective Action

SWMU 22 poses no unacceptable risks to human health or the environment. With this determination, JBC Weapons will make a note in the Installation Development Plan to ensure that safety notifications are documented for any future construction activities and personnel at the site. Safety notifications will be made through the base dig permit review process. This determination constitutes SCDHEC concurrence with the proposed remedy of NFI and Site Closure and the Air Force Unlimited Use/Unrestricted Exposure policy for SWMU 22.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 22.

AOC N: South Annex Potential Munitions Disposal Area along Rail Trestle
Potential Contaminants Investigated: Munitions and explosives of concern (MEC), munitions debris (MD), and potential munitions constituents (MC), and non-munitions-related debris (NMRD)
Media: Surface and subsurface soil
Proposed Remedy: Soil: Surficial Debris Removal and Existing Cover; Land Use Controls (LUCs)

Site Background

AOC N is a curvilinear MRS with approximately 10 acres of tidal marsh adjacent to an abandoned rail spur, which included a former earth-based rail bed and a former wooden rail trestle. AOC N is located west of Goose Creek, and includes an approximately 1-acre area under the waters of Goose Creek for a total of approximately 11 acres. Below and directly to the south of the former rail bed and trestle is a narrow stream of tidal water that runs through the center of the MRS. The remaining portions of the former rail trestle are in a dilapidated state, but are still present in the eastern portion of the MRS.

Historical evidence suggests that the AOC N MRS may have been used as a discard area for construction- and munitions-related materials. Loading and unloading of ordnance to and from ships moored at the Goose Creek piers occurred on a rail spur constructed in the marsh at the end of World War (WWI). The rail spur was built using fill for the rail bed and constructing a trestle in the eastern portion of the MRS to connect the track to the Goose Creek piers. Following WWI, munitions items may have been discarded or disposed of in the marsh from the former pier area or from the rail bed and trestle.

In addition to the rail trestle, there are a few buildings, roads, and parking areas located to the east/southeast of the MRS. These structures are currently or were previously associated with shipping activities to and from the Goose Creek piers. AOC N is currently unused, but there are plans to convert the western portion of the MRS (i.e., the area not associated with the abandoned rail trestle) into a mitigation wetland as part of a development project being conducted elsewhere at the installation. The future land use designation within the Installation Development Plan for JBC Weapons is open space/buffer zone.

Site Investigations

Three suspected MEC items (all 3-inch high explosive projectiles) were identified on the ground surface during the previously conducted Site Inspection (SI) (Tetra Tech NUS, Inc. [TtNUS], 2010). These items were subsequently disposed of by JBC Weapons Explosive Ordnance Disposal (EOD) personnel. In addition, four MEC items (Mark [Mk] II hand grenades) were identified and removed from AOC N during the MMRP IRA surface clearance fieldwork (**Figure 2**). No additional MEC, MD, or range-related debris (RRD) was identified at AOC N during the MMRP IRA or RI.

All munitions-related surface hazards were removed from the accessible portions of AOC N during the IRA surface clearance (URS, 2015). However, a potential for encountering MEC exists at the MRS, especially in areas that were inaccessible during the IRA and RI fieldwork. The east/central portions of AOC N contain intact but dilapidated sections of a former rail trestle. These areas were not safe to access during the IRA/RI fieldwork. Based on this, and

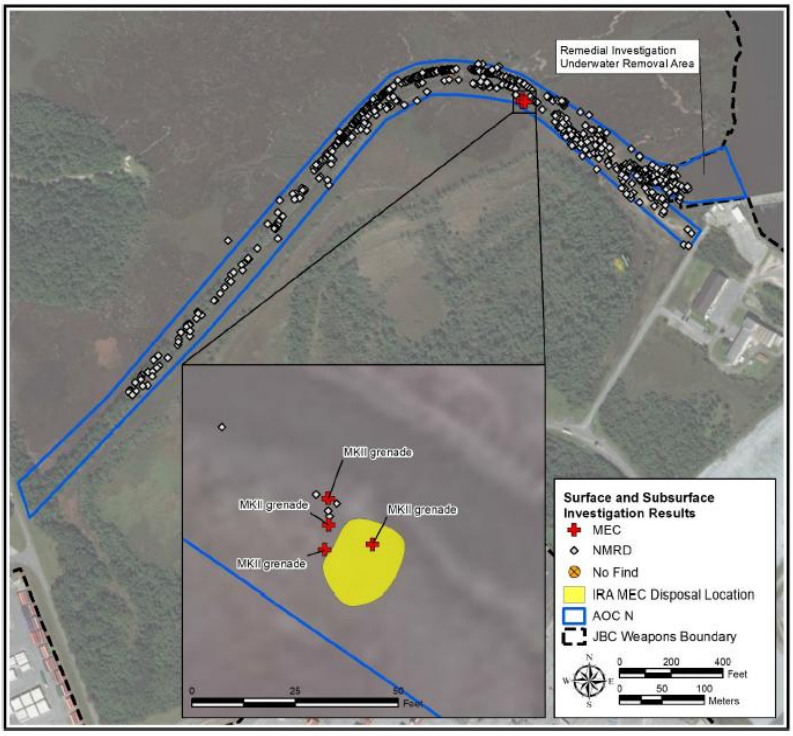


Figure 2. AOC N (XE002) Site Map

because MEC has been identified and removed from the MRS on multiple occasions, there are still potentially complete MEC exposure pathways remaining for the subsurface and inaccessible surface portions of the MRS.

The only media of concern for RI MC sampling at AOC N was sediment because the entire area sampled is in a tidal wetland along Goose Creek and a tributary stream. A total of 29 sediment samples were collected at AOC N for MC metals analysis. These media samples were collected to delineate potentially elevated metals concentrations observed in previously reported SI samples. In addition, to assess any potential explosive constituent contamination associated with the MEC (MK II hand grenades) identified and disposed at the MRS during the IRA (URS, 2015), three of the 29 samples (co-located with identified MEC), were also analyzed for MC explosives constituents in addition to MC metals.

Summary of SWMU Risks

All MC sample results were non-detect for explosives constituents. Data from the SI and RI indicating positive detections of MC were evaluated in the human health and ecological risk assessments. No constituents of potential concern were identified for the human health risk assessment, and screening criteria were based on residential land use. Therefore, no unacceptable risks were identified for site workers, recreational users/trespassers, or hypothetical future residents exposed to AOC N sediment.

During the ecological risk assessment, chromium, copper, and lead were retained and further evaluated as chemicals of potential ecological concern to the sediment invertebrate community. The ecological risk assessment concluded that all MC metals concentrations that exceeded the preliminary ecological screening criteria were below the probable effects limit for potential ecological receptors at the MRS. Therefore, no unacceptable risks were identified for ecological receptors.

The RI/FS also identified a significant quantity of NMRD had been left in place at AOC N. A majority of the NMRD left in place was associated with the abandoned rail trestle structure that transects the central portion of the eastern half of the MRS. These materials did not appear to be significant sources of chemical contaminants. More than 200 large and/or deeply embedded NMRD items were inspected, documented, and left in place during the IRA surface clearance and RI subsurface investigation due to access limitations, safety considerations, and to minimize disturbance to the wetland environment.

Proposed Corrective Action

The remedial alternative selected as part of the FS to address potential MEC at AOC N is MEC Alternative 2: LUCs and Construction Support. Based on information currently available, the USAF believes that MEC Alternative 2 (LUCs and Construction Support) best meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The USAF expects that the preferred Alternative of LUCs and Construction Support will satisfy both the statutory requirements of CERCLA (i.e., protection of human health and compliance with ARARs) and the existing RCRA permit.

MEC Alternative 2 (LUCs and Construction Support) includes developing and maintaining LUCs for AOC L. A LUC Implementation Plan (LUCIP) would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. The LUCIP documents the requirements for implementation, maintenance, and inspection of LUCs. LUCs would consist of institutional and engineering controls.

Institutional controls would include administrative mechanisms such as restrictions to prevent future construction activities at AOC L unless proper planning, permissions, and safety considerations are made. In addition, MEC Alternative 2 (LUCs and Construction Support) would require construction support for any future construction activities or other intrusive work completed within the MRS. Any future intrusive activities at AOC L could require an Explosives Safety Submission (ESS). LUCs are documented in the Installation Development Plan. The Base Remedial Project Manager (RPM) works with the 628 Civil Engineer Squadron Base Community Planner (Base Community Planner) to confirm that LUCs are

implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities).

Active land or construction management controls include the specification of protocols for projects planned to occur within the boundaries of a site while under the control of the property owner. At the Base, the RPM will review any project plans that may disturb AOC N. This review will take place prior to any construction or maintenance activity. This review is initiated when the Civil Engineer Squadron processes a dig permit where the RPM is one of the required approvers. If the planned activity constitutes a change in land use impacting AOC L, the RPM will notify SCDHEC as specified in the RCRA Permit. The RPM will also review plans for projects located at the site to ensure that they do not violate the LUCs and to determine if additional protections (e.g., construction support) are needed for construction workers or the surrounding environment. The development and implementation of a health and safety program may be required for activities taking place at a site.

Engineering controls would consist of installing signs or maintaining existing signs to warn site receptors of the potential surface and subsurface MEC risks remaining at the MRS (note that existing signs are in place at AOC N associated with the adjacent active EOD OB/OD range). Signs would be installed/maintained at access roads and around the MRS perimeter. Installation of signs, if necessary, would be completed by construction workers, supported by Unexploded Ordnance (UXO) personnel providing anomaly avoidance and would consist of a minimum of one UXO Technician II. The probability of encountering MEC along the perimeter of the MRS during sign installation is considered low, so an ESS is not anticipated to be required. Controls would be maintained, as needed, through future property transfers or until potential MEC hazards have been addressed.

Future decisions about land use would drive long term management (LTM) requirements. For example, if land use at AOC N changed from an undeveloped natural resources management area to another use (unlikely for AOC N), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

The remedial alternative selected as part of the FS to address potential NMRD at AOC N is NMRD Alternative 2: LUCs and Construction Support. Based on information currently available, the USAF believes that NMRD Alternative 2 (LUCs) best meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria.

NMRD Alternative 2 (LUCs) includes developing and maintaining LUCs for AOC N based on NMRD left in place. A LUCIP would be developed and the JBC Weapons RCRA Permit and Installation Development Plan would be updated as appropriate. LUCs would consist of institutional controls, including administrative mechanisms such as restrictions to prevent unauthorized intrusive activities within the MRS. Controls would be maintained, as needed, through future property transfers or until NMRD concerns have been addressed. LUCs are documented in the Installation Development Plan. The Base RPM works with the Base Community Planner to confirm that LUCs are implemented and enforced at applicable sites. Annual LUC inspections would be performed to confirm compliance with the LUCs (i.e., no change in land use or unreported construction activities). As described above.

Future decisions about land use would drive LTM requirements. For example, if land use changed from an undeveloped active munitions storage area to residential or some other use (unlikely for AOC N), LTM decisions would have to be made with respect to the appropriate response action required (e.g., additional controls or removal activities).

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at AOC N.

SWMU 67: South Annex Building 3674 Old Laboratory Waste Tank
Contaminants: Benzo(a)pyrene, Benzo(b)fluoranthene, 4,4'-Dichlorodiphenyldichloroethane (DDD), Dieldrin, Aroclor-1260
Media: Surface soil
Proposed Remedy: Excavation and Off-site Disposal, confirmation groundwater sampling

Site Background

SWMU 67 is located in the northeastern corner of the South Annex between Building 3674 and Hooker's Lake. SWMU 67 is the location of two underground waste storage tanks. In the early 1960s a 55-gallon underground waste tank was located approximately 11 feet from the east side of Building 3674 and was used to hold wastes from a "slop drain" within the building. Based on a construction drawing, it is assumed that Building 3674 was once the petroleum, oil, and lubricants laboratory. There is no drain field associated with the tank on facility drawings. In 1968, the 55-gallon tank and the associated influent piping were removed, and a 1,000-gallon concrete underground industrial waste tank was installed approximately 10 feet northeast of the 55-gallon tank. Two sinks inside of Building 3674 discharged to the original "slop drain" that was connected to the concrete tank which is estimated to have been used between 1968 and 1974. No drain lines are shown on facility figures, which also shows the effluent hole as being plugged and grouted with concrete; therefore, no drain lines or drain field is presumed to be associated with this tank. This tank is currently present outside of Building 3674, and was closed in place during the Interim Measure (IM) that was conducted in 2005 (TolTest, 2005).

Site Investigations

Several investigations have been conducted at SWMU 67 (DC067). A RCRA Facility Assessment (RFA) was completed in 1997 (WPNSTA Charleston, 1997). During the RFA, the concrete underground industrial waste storage tank was located and found to contain a small amount of residual wastewater. A sample of the residual wastewater was collected and analyzed per 40 Code of Federal Regulations part 264 Appendix IX constituent list - volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. It was recommended that the tank be removed and samples collected.

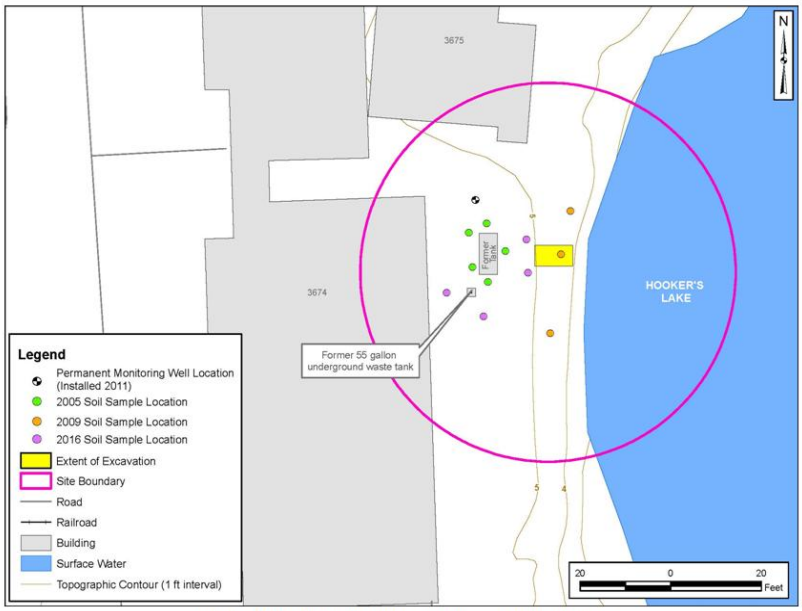


Figure 2. SWMU 67 (DC067) Site Map and Proposed Excavation Area

An IM was conducted in 2005 and the 1,000-gallon tank was closed in place (TolTest, 2005). The site was too encumbered with utilities to remove the tank, so it was instead abandoned in place by filling the tank with flowable grout. Prior to abandoning the tank, the tank contents were sampled. The sample was analyzed for Toxicity Characteristic Leaching Procedure (TCLP) constituents and found to be non-hazardous; analytical results were less than detection limits. Approximately 1,000 gallons of liquid were removed via vacuum truck. The tank was then power washed with water and a mild detergent, and the wash water removed via vacuum truck. It was noted that the tank had a small leak in the floor and was taking on water. Therefore, the tank was again emptied of approximately 50 gallons via vacuum truck immediately before grouting in place. The associated aboveground piping was removed from the tank; however, because of utility interferences, intrusive investigation of any

additional piping associated with the tank was not performed. Five confirmation soil samples were collected in a 1-foot radius beyond the tank, from depth intervals of 6 to 12 inches below ground surface (bgs) (see Figure 2). Three temporary wells were also installed around the periphery of the tank. VOCs, SVOCs, arsenic, and lead constituents were identified in the groundwater samples; and polychlorinated biphenyls (PCBs) were identified in the soil samples collected at the site. It was recommended that an RFI be implemented at SWMU 67 (DC067) to determine the nature and extent of soil and groundwater contamination; and characterize the shallow aquifer.

An RFI was conducted in 2009 (Tetra Tech, 2011a). Four surface soil samples, including one duplicate, four groundwater samples, and two surface water samples were collected during the RFI. Several SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene) were detected in the surface soil sample collected downgradient (east) of the tank, between the tank location and Hooker's Lake, at concentrations that exceeded residential screening levels. These SVOCs were not detected in any of the groundwater or surface water samples collected at SWMU 67. Pesticides (4,4'-DDD, 4,4-DDE, 4, 4-DDT, alpha-chlordane, chlordane, dieldrin, gamma-chlordane, and heptachlor epoxide) were detected in all surface soil samples and PCBs were detected in two of four surface soil samples, some of which were at concentrations greater than residential screening and facility background levels. Pesticides were also detected in groundwater samples with only dieldrin detected at a concentration that exceeded screening criteria. Metals were not detected in the surface soil or groundwater at concentrations that exceeded residential screening criteria in place at the time. No further investigation was recommended for soil. However, installation of a permanent well was recommended to monitor groundwater.

One permanent monitoring well was installed at SWMU 67 in 2011 (Tetra Tech, 2011b). Metals, VOCs, pesticides, PCBs, and polycyclic aromatic hydrocarbons (PAHs) were all detected at concentrations less than maximum contaminant levels (MCLs) and RSLs in the sample collected from this well. However, due to utility interferences, the well was placed north (i.e., cross-gradient) of the tank. It was recommended that a long-term monitoring plan be developed for SWMU 67 to evaluate the viability of sampling pore water just offshore (east) of the former tank location, and surface water just east of the tank location to obtain data representative of groundwater directly downgradient of the tank.

In 2012, one groundwater sample was collected from the permanent monitoring well installed in 2011, and one surface water sample was collected from Hooker's Lake. VOCs and metals were detected in the groundwater sample, and metals were detected in the surface water sample; however, all were detected at concentrations less than MCLs, RSLs, and facility background levels (TEC-BSC Joint Venture, 2013).

A CMS was completed in 2011 to evaluate remedial alternatives for SWMU 67 (Tetra Tech, 2011b). Based on evaluations completed as part of this study, land use controls (LUCs) and long-term monitoring of groundwater was chosen as the recommended remedial alternative. SCDHEC provided comments on the CMS Report and requested additional investigation of subsurface soil and associated piping that may remain in place in order to determine the horizontal and vertical extent of contamination, and to evaluate active remedial alternatives (if necessary) based on the investigation results. SCDHEC conditionally approved the CMS Report on the basis that the investigation would be conducted. None of the corrective measures identified in the conditionally approved 2011 CMS were implemented pending completion of the required additional data collection.

Based on comments received from SCDHEC on the conditionally approved 2011 CMS, a Focused CMS Work Plan was developed to better define the extent of soil contamination and potentially impacted groundwater associated with the underground tank at SWMU 67 (Tetra Tech, 2016). During the 2016 CMS Investigation, eight soil samples plus one duplicate sample were collected from four soil borings, and the existing groundwater monitoring well was sampled (Tetra Tech, 2017a).

In 2005, the concentration of Aroclor-1260 exceeded the project action level (PAL) in one soil sample, while concentrations of Aroclor-1260, 4,4'-DDD, dieldrin, and several PAHs exceeded PALs and facility background levels in one soil sample collected in 2009 from the 0- to 1-foot bgs interval. Chemical concentrations in all soil samples collected in 2016 were less than PALs for residential soil and facility background levels. The PALs for soil are based on USEPA RSLs for residential soil. The chemical results from the soil samples were used to determine that additional groundwater well installation and investigation near the waste tanks was not warranted during the 2016 CMS Investigation. One PAH was detected at a concentration that exceeded the PAL (based on a residential groundwater use scenario) in the 2016

groundwater sample. The PALs for groundwater are based on MCLs; if there is no MCL, then the PAL is based on the USEPA RSL for tapwater. Soil and groundwater sample locations are shown on **Figure 2**.

Summary of SWMU Risks

The human health risk screening evaluation (HHRSE) for SWMU 67 was initially conducted as part of the RFI process and concluded that cancer risks and hazard indices (HIs) were within acceptable levels. The HHRSE was updated as part of the Focused CMS Investigation (Tetra Tech, 2017a) to include the new soil data and groundwater data collected since completion of the RFI (Tetra Tech, 2011b). The HHRSE was also updated because new USEPA default exposure assumptions (used to estimate risks) for some exposure factors had been published, toxicity criteria for some chemicals had been updated, and the USEPA RSLs had been updated since the RFI report (Tetra Tech, 2011b) was completed.

The surface soil cancer risks and HIs assume a future resident is exposed to chemicals of potential concern (COPCs) in surface soil. Cancer risks for exposures to surface soil are equal to the target risk level of 1×10^{-5}, although the concentration of dieldrin exceeds the MCS in surface soil in the location just downgradient of the 1,000-gallon tank and is considered to be a COC for surface soil, therefore, requiring remediation. The HI for hypothetical future residential exposure to surface soil is less than the risk management benchmark of 1 (i.e., unacceptable non-cancer risks are not anticipated). Concentrations of all chemicals in subsurface soil were below screening levels; therefore, no chemicals were retained as COPCs for subsurface soil.

The groundwater cancer risks and HIs assume groundwater is used as a residential (domestic) water source. The cancer risk for groundwater at SWMU 67 is less than the target risk level and HIs for exposures to groundwater; therefore, MCSs were not calculated for groundwater.

MCSs were calculated for surface soil. The MCSs correspond to cancer risk levels for USEPA's target risk range of 10^{-4} to 10^{-6} and a hazard quotient of 1; therefore, MCSs were only calculated for analytes whose risk level exceeded the USEPA target levels. The recommended MCSs are based on the target risk management levels of $1 \text{ X } 10^{-5}$ or an HI of 1.

Proposed Corrective Action

The remedial alternative selected to address contamination at SWMU 67 is Alternative 2: Excavation and Off-site Disposal. Alternative 2 includes temporary implementation of Land Use Controls to prevent intrusive activities and use of groundwater until removal of identified soil contamination is complete. During the excavation an additional groundwater sample will be taken. Excavated soil would be transported for off-site disposal. It is assumed based on analysis of investigation derived soil waste that the excavated soil would be classified as non-hazardous waste. Limits of the proposed excavation area are shown on **Figure 2**. None of the excavated material is expected to be classified as hazardous waste. The maximum depth of the excavation is expected to be 1 foot bgs. Confirmation sampling following excavation would confirm that soil MCSs have been met and that groundwater concentrations remain within the target risk levels. Approximately 1.48 cubic yards of soil would be excavated (approximately 40 square feet to a depth of 1 foot) at SWMU 67 (DC067) and disposed off-site. After excavation and off-site disposal, the area would be graded, restored, and reseeded with grass.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 67.

SWMU 7 – MENRIV Navy Exchange Underground Waste Oil Tanks (also known as Building 724, Facility ID 01797, Release #37)
Contaminants: None
Media: None
Proposed Remedy: Land Use Controls (LUCs)

Site Background

Building 724 is an active filling station and convenience store located on the west side of the JBC Weapons facility in Goose Creek, Berkeley County, South Carolina. The site is currently managed under the SCDHEC UST Program (Facility ID 01797, Release #37). In 1992, SWMU 7 was included in the installation's 1992 Hazardous Waste Permit under Appendix A-4, "List of Solid Waste Management Units and Areas of Concern requiring confirmatory sampling". The SWMU 7 site description in Appendix A-4 of the 1992 permit was "Underground Waste Oil Tanks" (SCDHEC, 1992). As requested in the April 1998 letter from the Department of the Navy to SCDHEC, SWMU 7 was transferred from the RCRA Corrective Action Program to RCRA Subtitle I (UST Program) as part of the 1998 RCRA Permit renewal for the installation. According to the 1998 RCRA Permit for the installation (SCDHEC, 1998), SWMU 7 was listed in Appendix A-8 "List of solid waste management units (SWMUs) and areas of concern (AOCs) transferred to the Subtitle I of RCRA." The site description in the 1998 RCRA Permit was "MENRIV Navy Exchange Underground Waste Oil Tanks." The site is currently listed in the Joint Base Charleston's RCRA Permit as SWMU 7 - MENRIV Navy Exchange Underground Waste Oil Tanks. The site was originally identified in the RA for JB CHS-Weapons, but was subsequently transferred to the SCDHEC UST Program.

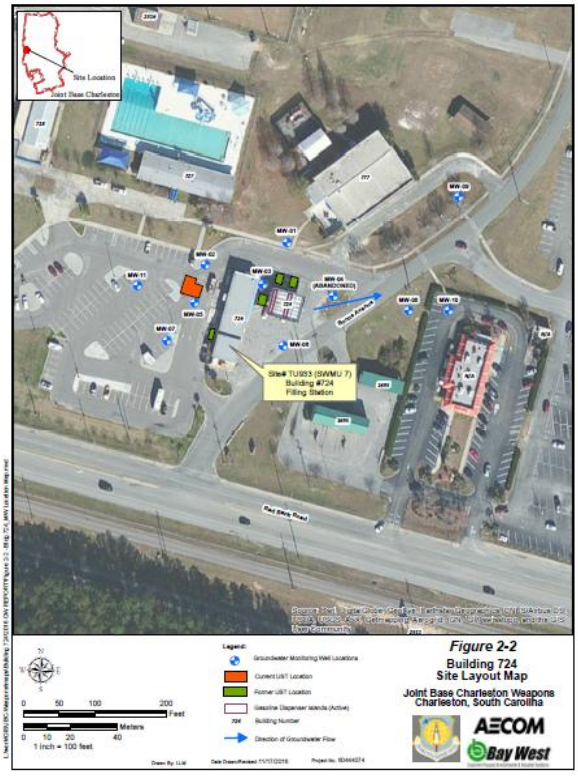
The original service station consisted of two 10,000-gallon steel USTs located on the north side of the dispenser islands, one 5,000-gallon steel UST located on the west side of the dispenser islands, and two 550-gallon used oil USTs located east of the building. The original USTs were closed in place in 1991 and replaced with three gasoline USTs with capacities of 10,000 (two tanks) and 6,000 gallons (one tank), and one 1,000 gallon used oil UST. The replacement gasoline USTs were installed east of Building 724 and the 1,000 gallon used oil UST was installed at the same location as the removed used oil USTs. The tanks installed in 1991 were each replaced again in 1997 with double walled fiberglass tanks of the same capacity. The USTs installed in 1997 remain in place at the site, east of the convenience store (**Figure 2-2**). The 1,000 gallon used oil UST is no longer in use at the service station and was closed in place in March 2015. Details on the March 2015 UST closure are provided in the May 13, 2015 *UST Assessment Report for NWS Building 724*, prepared by Joint Base Charleston (Joint Base Charleston, 2015).

The current fueling station contains two pump islands and three double walled fiberglass USTs with capacities of 10,000 (two tanks) and 6,000 gallons (one tank), and one double walled fiberglass 1,000-gallon used oil UST. The 1,000-gallon used oil UST was closed in place in 2015 and the remaining three USTs are active. Two service bays at the building were formerly used for maintenance of JBC Weapons and private vehicles. Vehicle maintenance is no longer performed at the facility. The location of the convenience store, the current and former USTs, and the dispenser islands are presented in **Figure 2-2**.

Site Investigations

In 1988, the two 550-gallon used oil USTs associated with Building 724 were identified as Solid Waste Management Unit (SWMU) 7 in the Interim Resource Conservation and Recovery Act (RCRA) Facility Assessment (A.T. Kearney, 1988). At the time, these two USTs reportedly received used oil and other petroleum products from the service station and lacked secondary containment. In 1990, the two original 550-gallon used oil USTs were replaced and approximately 100 cubic yards of soil were removed for disposal. Based on an April 1998 letter from the Department of the Navy to SCDHEC, soil samples were not collected at the time of the removal and as such, no determination was made regarding the impact of the waste oil USTs on the surrounding soil and groundwater media. According to both April 1998 letter from the Department of the Navy to SCDHEC and the 2001 Hydrogeologic Assessment Report (General Engineering, 2001), the two original waste oil tanks were replaced with a 1,000-gallon waste oil UST during the 1990 UST removal/replacement activities.

In 1996, a leaking hydraulic oil UST was discovered in the former service bay area at Building 724, located approximately 20 feet east of SWMU 7. Reportedly, approximately 30 gallons of hydraulic fluid were lost from the system (General Engineering, 1997a). The SCDHEC UST Division issued LUST ID 17589 for the hydraulic oil spill and a release assessment was conducted in November 1996. The release assessment consisted of the installation and sampling of two temporary wells (designated TW-1 and TW-2) in the vicinity of the hydraulic oil tank. The investigation did not identify subsurface soil contamination or significant levels of dissolved phase petroleum constituents in the groundwater; however, one of the wells was identified as containing free product (well TW-2). The report (General Engineering, 1997a) recommended the installation of additional temporary wells to delineate the extent of free product in the vicinity of the hydraulic fluid UST.



In February 1997, a Phase I confirmation sampling event was conducted for SWMU 7. The sampling at SWMU 7 was conducted as part of a broader investigation that included 27 SWMUs and 2 areas of concern (AOCs) at JBC Weapons. At SWMU 7, sampling three direct push groundwater sampling points were installed and sampled east/northeast of the waste oil tank. The results of the investigation identified benzene and methyl tert-butyl ether (MTBE) in wells located northwest of the used oil tank (Brown and Root Environmental, 1997). The report for this investigation contained no recommendations.

In June 1997, a follow-on investigation was conducted in the vicinity of the hydraulic fluid UST spill (LUST ID 17589) located in the former service bay area at Building 724 approximately 20 feet east of SWMU 7 (General Engineering, 1997b). The investigation consisted of the installation and sampling of two additional temporary wells (designated TW-3 and TW-4) in the vicinity of the hydraulic oil tank. No dissolved phase petroleum constituents were detected in the groundwater at the two new temporary well locations. The report recommended continued removal of free product from MW-02 and abandonment of TW-1, TW-3, and TW-4 (General Engineering, 1997b). JBC Weapons personnel subsequently conducted free phase product measurement and removal using an in-well passive product skimmer. In November 2005, product level thickness measurements were less than 0.01 inch and the installation requested no further action status for LUST ID 17589. According to the *Third Quarter Groundwater Monitoring Report, Air Sparge Remediation System Monitoring* (General Engineering, 2008), SCDHEC issued a No Further Action finding for the hydraulic oil release (LUST ID 17589) at Building 724 in a letter dated February 26, 2007.

From October 2000 through February 2001, General Engineering assessed the nature and extent of petroleum related impacts at the site (General Engineering, 2001). The objective of the investigation was to evaluate the impact to soil and groundwater in the vicinity of the former waste oil UST (SWMU 7) and the surrounding properties within a 1,000-foot radius of SWMU 7. Soil samples were collected at 6 locations adjacent to the former waste oil UST to evaluate soil impact in the suspected source area. In addition, groundwater samples were collected from 23 locations using direct push technology (DPT) to delineate the zero-impact boundary of dissolved constituents in groundwater. Nine permanent shallow groundwater monitoring wells were installed based on an evaluation of the DPT groundwater data. The results of the investigation indicated no significant impact to soil or groundwater in the vicinity of SWMU 7. Based on the nature and extent of petroleum constituents in groundwater, the groundwater contamination was attributed to the piping and dispensers used for the gasoline USTs rather than the used oil UST (General Engineering, 2001). It was further concluded that a 10,000-gallon active UST at the site had been leaking. Based on these results, General Engineering recommended the leaking gasoline UST be repaired to ensure that impact to the subsurface soil and groundwater did not continue, a soil assessment in the vicinity of the active UST system and in the vicinity of the gasoline dispensers be conducted to determine

the appropriate remedial option for soil and groundwater at the site, and routine quarterly monitoring be conducted to monitor plume migration and to determine if downgradient receptors are being impacted (General Engineering, 2001).

In April 2002, a subsurface soil and groundwater investigation was performed at the site to determine the extent of contamination related to the release from the active gasoline UST system (General Engineering, 2002). The investigation included the construction and sampling of 38 soil borings around the former and current UST systems located east and west, respectively, of Building 724. Two additional monitoring wells (MW-10 and MW-11) were installed in 2002 subsequent to the subsurface soil investigation in an effort to delineate the contaminant plume. Benzene, toluene, ethylbenzene, and xylenes (BTEX); naphthalene; benzo(a)pyrene; and benzo(b)fluoranthene were detected in some of the soil samples above the SCDHEC Risk-Based Screening Levels (RBSLs). The highest concentrations of these constituents were detected near the fuel dispensers and closed-in-place gasoline USTs. Details are provided in the Soil and Groundwater Assessment Report (General Engineering, 2002).

On November 26, 2003, General Engineering submitted a Corrective Action Plan/Engineering Report to SCDHEC. The report outlined remedial design considerations for the installation of an air sparge remediation system for the site. General Engineering installed 21 air sparge wells to a depth of 21 feet from October 25 to November 7, 2005. Five of the wells were reinstalled on August 21, 2006 at depths ranging from 12.5 feet to 15 feet due to clays at the deeper depth not allowing for adequate air flow into the subsurface (General Engineering, 2003).

According to the *Third Quarter Groundwater Monitoring Report, Air Sparge Remediation System Monitoring* (General Engineering, 2008), the air sparge system was operated periodically from late 2006 until mid-2008. During this time period, there were multiple complications with the system's operation including, but not limited to, groundwater daylighting at the surface and vapor intrusion into the on-site retail store. In the Spring of 2008, a timer was installed on the air pump to allow for operation of the system during the non-business hours of the store. Beginning on June 16, 2008, the system was run for seven hours a day Monday through Saturday and 24 hours on Sundays (General Engineering, 2008).

In April 2009, General Engineering conducted a trial run of the air sparge system during business hours and no odors were detected in the store. The air sparge system ran continuously after this trial until the air pump failed in late 2009. According to the 2011 Annual Groundwater Monitoring Report (JBC Weapons, 2011), the groundwater plume was isolated to the area around the active UST basin (i.e., monitoring well MW-05) when the air pump failed. At that time, a decision was made to not repair the pump.

Following startup of the air sparge system, groundwater sampling events occurred semi-annually in 2008 and 2009. Annual groundwater sampling has occurred for BTEX, MTBE, and naphthalene since 2010. Through 2013, groundwater sampling was performed at 10 onsite groundwater monitoring wells for laboratory analysis of BTEX, MTBE, and naphthalene (monitoring well MW-04 was closed in early 2005 due to interference with the air sparging operations). In late 2009, the air sparge system failed due to a mechanical problem with the air pump. Because the groundwater contaminant plume was shown to be isolated around a single monitoring well (MW-05), the air sparge system was left off anticipating the contamination would degrade or attenuate naturally without having to repair and reactivate the system.

Summary of SWMU Risks

According to the SCDHEC Quality Assurance Program Plan (QAPP) for the Underground Storage Tank Management Division document dated May 2015, a Conditional No Further Action (CNFA) may be issued upon the Agency's concurrence that the petroleum CoC concentrations are less than site-specific target levels (SSTLs) but still greater than the RBSLs. Such decisions can be reached only when verification monitoring documents that natural attenuation is taking place, and that no risk to human health or environment will result. A CNFA decision can be granted by SCDHEC once the following has been demonstrated:

- The site-specific targets levels (SSTLs) have been met;
- The COCs have reached equilibrium or are not moving at a significant rate;
- Concentrations of COCs are not increasing;

- No unacceptable risk to human health, safety, or the environment exists; and
- Concentrations of COCs will not exceed RBSLs at the exposure point or receptor.

On January 8, 2016, SSTLs were calculated for the site by Joel Padgett of SCDHEC for constituents at the site that exceeded their RBSL (benzene, naphthalene, and MTBE). Therefore, the SSTLs calculated on January 8, 2016 are the remedial objectives for the site. The April 2015 groundwater analytical results are several orders of magnitude below the calculated SSTLs. Groundwater has been monitored at the site on an annual basis, at a minimum, from 2008 through 2015. Prior to the air sparge system operating (June 2008 through late 2009); the groundwater contaminant plume was approximately 350 feet in length and 80 feet in width. Currently, the plume is approximately 100 feet in length and 40 feet in width. This plume configuration has remained stable over several years of groundwater monitoring.

Based on historical groundwater analytical results, the groundwater contaminant plume is localized primarily around the active UST basin (monitoring well MW-05) and appears to be decreasing naturally over time.

Proposed Corrective Action

Based on the absence of free product in all site wells, the stability of the plume, and the decreasing contaminant concentrations, concentrations of COCs will not "exceed RBSL at the exposure point or receptor." In addition, all COC concentrations are well below the SSTLs. Therefore, all five qualifications to be considered for a CNFA have been met, as applicable. As a result, a CNFA is warranted for Release #37 under UST Permit #01797 in accordance with the SCDHEC UST regulations. The CNFA requirements will be tracked in the Land Use Control Table within the Permit.

Anticipated Impacts of Cleanup on the Local Community

No significant impacts to the local community are associated with the proposed remedy at SWMU 7.

SWMU 69 –South Annex Petroleum, Oil, and Lubricants (POL) Decanning Facility Septic Tank
Contaminants: Chlorinated Volatile Organic Compounds (cVOCs) and 1,4-Dioxane
Media: Groundwater
Proposed Remedy: Interim measure soil removal, Groundwater Monitoring, and Land Use Controls (LUCs)

Site Background

SWMU 69 (FL069) - South Annex POL Decanning Facility Septic Tank is located in the south-central portion of the South Annex and consists of a manicured grassy flat area about 20 by 20 feet between 8th Street and the former location of Building 3489. The base sanitary sewer system map, dated September 1, 1970, identified a 1,000-gallon concrete septic tank as number “86”. A Drum Re-Conditioning Plant was constructed in 1968, during the same time as the rest of the Decanning Facility. The Decanning Facility was constructed for packaging and repackaging petroleum, oil, and lubricants (POL) products for the Army. The septic tank was located adjacent to the old POL Re-hab Shed (former Building 3489). The septic tank is estimated to have operated between 1968 and 1974. A drain that exists at the northern end of former Building 3489 within the SWMU 69 site boundary was investigated during the 2016 CMS Investigation. No soil contamination or other impacts associated with the drain were identified and no other distinguishing features remain at the site.

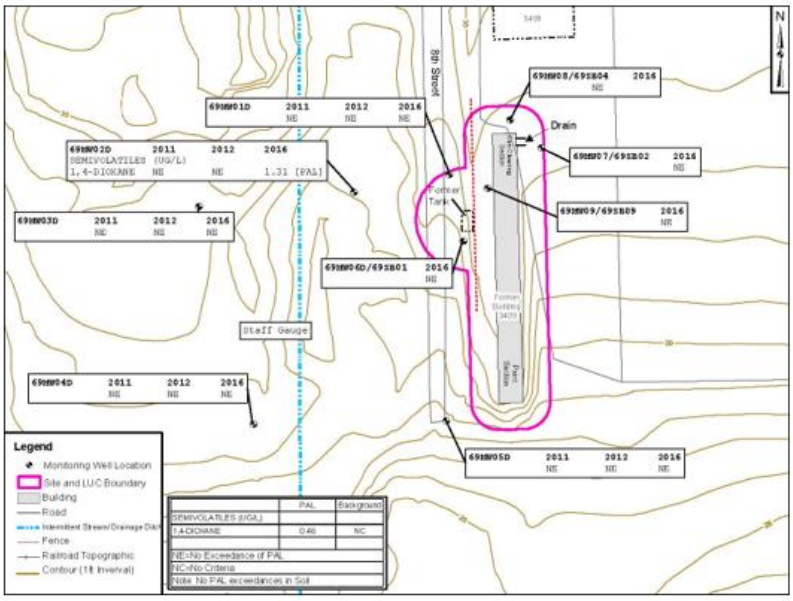


Figure 2. SWMU 69 (FL069) Monitoring Well Locations, Groundwater Exceedances, and LUC Boundary

Site Investigations

Several investigations have been conducted at SWMU 69. A RCRA Facility Assessment (RFA) was completed in 1997 (WPNSTA Charleston, 1997). During the RFA, the SWMU 69 septic tank was located. A sample of the residual wastewater was collected and analyzed for Appendix IX metals and select volatile organic compounds (VOCs). Total xylenes, barium, cobalt, and lead were detected. Only lead was detected at a concentration greater than its Maximum Contaminant Level (MCL) of 15 micrograms per liter (µg/L). It was recommended that the tank be removed and samples collected. Interim Measures (IM) were conducted in 2005 including removal of the tank and associated piping; removal and disposal of excavated nonhazardous soil; and sampling and removal of approximately 1,000 gallons of liquid from the tank (determined to be nonhazardous). After the tank was removed, five confirmatory soil samples were collected from the four sidewalls and bottom of the excavation. Soil samples were collected at approximately 4 feet below ground surface (bgs). Soil samples were analyzed for Target Analyte List (TAL) metals and Appendix IX pesticides, polychlorinated biphenyls (PCBs), herbicides, VOCs, and semi-volatile organic compounds (SVOCs); there were no detections greater than screening criteria and background. Because groundwater data were not collected during IM activities, it was recommended that an RFI be conducted at SWMU 69 (FL069) to confirm the assumption that groundwater had not been impacted; synoptic water level measurements and aquifer testing were also recommended to characterize the aquifer.

A RFI was conducted in 2009 (Tetra Tech, 2011a). Groundwater samples were collected from temporary monitoring wells (13 shallow and 15 deep) during the RFI at SWMU 69. VOCs and metals were detected in both the shallow and deep groundwater samples. Trichloroethene (TCE), a cVOC, was detected in 5 of 15

deep groundwater samples; TCE concentrations exceeded screening criteria (MCL) in three samples collected from the deep groundwater wells. A TCE plume was identified to the west-southwest of former Building 3489. Groundwater in these deep wells was measured at depths of approximately 5 to 10 feet bgs. No further investigation for soil was recommended in the RFI. Monitoring for VOCs was recommended for groundwater along with installation of permanent monitoring wells. It was also recommended that the SWMU 69 site boundary be expanded to include the groundwater plume and the footprint of former Building 3489.

Five permanent deep monitoring wells (screened at 21 to 24 feet bgs) were installed into the surficial aquifer (69MW01D, 69MW02D, 69MW03D, 69MW04D, and 69MW05D) in 2011 (Tetra Tech, 2011b). Monitoring well locations are shown on **Figure 2**. Depth to water was 5 to 10 feet bgs and both shallow and deep groundwater flow was to the southwest with a slight westerly component of the drainage ditch. When the surface water elevation in the drainage ditch was considered, groundwater contours indicated that a portion of the shallow groundwater discharged to the drainage ditch from both sides of the ditch. cVOC results from this groundwater monitoring event were significantly less than screening criteria (United States Environmental Protection Agency [USEPA] Regional Screening Levels [RSLs] for tap water [tap water RSL] or MCLs). Concentrations of TCE decreased from a maximum groundwater concentration (for deep groundwater) of 14 µg/L during the RFI to 0.5 µg/L during the 2011 monitoring event. Because a small plume of TCE at concentrations significantly less than those previously measured likely remained, short-term monitoring to track migration and plume stability was recommended.

A CMS was completed in 2011 to evaluate remedial alternatives for groundwater (Tetra Tech, 2011c). Based on evaluations conducted as part of this report, LUCs for groundwater and monitoring of groundwater were the recommended remedial alternative. SCDHEC also agreed with the recommendation from the RFI to make the SWMU 69 boundary larger, however, SCDHEC noted that with the expansion of the site boundary, the drain to the north of Building 3489 becomes part of SWMU 69 (FL069) and would require further investigation including the collection of surface and subsurface soil samples. The investigation of the pipe discharge along with how it received waste were also recommended. None of the corrective measures identified in the 2011 CMS that was conditionally approved by SCDHEC were implemented pending completion of the required additional data collection.

A round of groundwater samples were collected in 2012. Chloroform, 1,1-dichloroethene, cis-1,2-dichloroethene, and TCE were detected in at least one monitoring well at concentrations less than screening criteria (tap water RSLs or MCLs) during this monitoring event (TEC-BSC Joint Venture, 2013). TCE was detected in one monitoring well, 69MW01D, at an estimated concentration of 0.292 µg/L during the 2012 monitoring event.

Based on comments received from SCDHEC on the conditionally approved 2011 CMS, a CMS Work Plan was developed to describe the plan for collecting additional data (Tetra Tech, 2016) to: further delineate SWMU 69, including the drain at the northern end of former Building 3489; investigate the industrial wastewater system including the potential discharge location; and determine the presence or absence of 1,4-dioxane in accordance with United States Air Force (USAF) guidance on 1,4-dioxane sampling (USAF, 2013). If 1,4-dioxane is detected, continue with additional characterization; if 1,4-dioxane is not detected then no additional investigation is warranted. During the 2016 CMS Investigation, four permanent groundwater monitoring wells were installed (69MW06D, 69MW07, 69MW08, and 69MW09; see **Figure 2** for locations), water level measurements were collected, and a round of groundwater samples was collected from the four newly installed monitoring wells and the five existing permanent monitoring wells for analysis of cVOCs (organic analytes with exceedance of screening criteria during previous sampling events), 1,4-dioxane, ethene, and natural attenuation parameters. Also, one subsurface soil sample was collected from each of four soil borings in the wastewater system drain discharge location at the northern end of former Building 3489 for cVOCs and 1,4-dioxane analysis.

All analytes detected in soil during both the 2016 CMS Investigation and the 2005 IM were detected at concentrations less than PALs (i.e., tap water RSLs or MCLs). Groundwater analytical results from 2011, 2012, and 2016 were compared to PALs based on a residential scenario and background. Monitoring well locations and exceedances of PALs and facility background for all groundwater samples are presented on

Figure 2. TCE was detected during the 2016 CMS Investigation in one well (69MW01D), at a concentration exceeding the tap water RSL (0.49 µg/L) but less than the MCL (5 µg/L). Chloroform was also detected in one well (69MW05D) at a concentration exceeding its tap water RSL (0.22 µg/L) but less than its MCL (70 µg/L). Note that the MCLs are the PALs for TCE and chloroform; therefore, the detected concentrations do not exceed PALs. All VOC concentrations in the newly-installed monitoring wells were less than detection limits, including wells 69MW07, 69MW08, and 69MW09 near and downgradient of the drain. 1,4-Dioxane was detected at a concentration exceeding its RSL of 0.46 µg/L at one monitoring well, 69MW02D. It should be noted that there is no MCL for 1,4-dioxane. As specified in the CMS Work Plan for SWMU 69, a detection of 1,4-dioxane is considered as confirmation of the presence of 1,4-dioxane and further sampling is not required for completion of the CMS. However, the USAF proposes to include 1,4-dioxane in the list of constituents to be monitored to demonstrate that the level detected previously remains stable and does not present a risk to hypothetical future residents.

Summary of SWMU Risks

The media evaluated at SWMU 69 include subsurface soil and groundwater (Tetra Tech, 2017a). The human health risk screening evaluation (HHRSE) for SWMU 69 was conducted as part of the 2016 CMS Investigation (Tetra Tech, 2017a). The concentrations of all chemicals detected in subsurface soil were less than the residential soil RSLs and facility background levels (Tetra Tech, 2017b). Therefore, no chemicals of potential concern (COPCs) were identified for subsurface soil.

Only the 2016 analytical results were used in the groundwater evaluation since they are more representative of current conditions at SWMU 69. Concentrations of TCE and 1,4-dioxane in groundwater exceeded their RSLs, and facility background concentrations are not established for these analytes; therefore, these chemicals were retained as COPCs. Cancer risks and hazard indices assume groundwater is used as a residential (domestic) water source at SWMU 69. The cancer risk for residential exposure to groundwater COPCs at SWMU 69 is less than the target risk management level of 10^{-5} and the risk management benchmark of 1. Consequently, no analytes were retained as chemicals of concern for residential exposure to groundwater.

Proposed Corrective Action

The proposed remedy for SWMU 69 is groundwater monitoring for cVOCs and 1,4-dioxane and LUCs. Because exposure to soil and groundwater at SWMU 69 does not present an unacceptable risk to human health or the environment, an evaluation of corrective measures in a CMS was not required. However, per the RCRA Permit, analytical results of all cVOCs in groundwater must remain stable or at concentrations less than PALs for a minimum of three consecutive events before it can be determined that NFA is required at a given site. Therefore, additional groundwater monitoring for cVOCs and 1,4-dioxane, following the 2016 event, is recommended at the permanent groundwater monitoring wells installed in 2016 (69MW06D, 69MW07, 69MW08, 69MW09) to ensure that cVOC concentrations, including 1,4-dioxane, remain less than PALs, or remain stable at current levels presenting no risk to hypothetical future residents for two additional rounds. A site closure recommendation will be made for SWMU 69 when groundwater concentrations have remained stable or below PALs for three consecutive events.

Anticipated Impacts of Cleanup on the Local Community

No significant impacts to the local community are associated with the proposed remedy at SWMU 69.

SWMU 29 – South Annex Building 3820Contaminants: None
Media: None
Proposed Remedy: No Further Action (NFA)

Site Background

SWMU 29 – South Annex Building 3820 was used for railcar cleaning. Two underground concrete industrial waste septic tanks, located next to Building 3820, were used to collect drainage wastes from the building and cleaning pad. Each tank had a capacity of approximately 1,000 gallons. The tanks were installed in the late 1960s and were taken out of service in the mid-1980s. There are no records of remedial actions such as emptying or flushing of the tanks. The building was destroyed in 1989 during Hurricane Hugo and was subsequently removed.

In 2000, the tanks were removed, cleaned, and properly disposed of, and their contents were analyzed. All that remains of the site is a concrete pad, which was the railcar cleaning pad. Rail lines that passed through the building are now covered. The SWMU was originally investigated based on the previous use for washing equipment coming from overseas. The site is an industrial area of the base and is currently unused.

Site Investigations

A Phase I RFI was conducted in 2004, and a Phase II RFI was conducted in 2006. Supplemental sampling for Phase II was completed in 2007. The Phase I RFI included the collection of groundwater samples from seven temporary monitoring wells and soil samples from nine soil borings at SWMU 29. The soil samples were collected to investigate influent and effluent piping from the two former tanks and to investigate areas adjacent to the building as warranted by historical information, including an area of former staining and a former paint shed shown on facility design drawings (Figure 2). The Phase II RFI included additional soil investigation with collection of soil samples from six soil borings. Six sediment samples were collected from Goose Creek adjacent to SWMU 29 during the Phase II supplemental work of March 2007 as part of a larger sampling effort for Goose Creek. The samples were collected in Goose Creek from the SWMU 29 piping outfall (Figure 2). Soil, groundwater, sediment, and tank contents were evaluated in the *Phase I and Phase II RFI Report – SWMUs 25, 28, 29, 40 and Confirmatory Sampling Report – SWMU 71 and AOC H* (TtNUS, 2008). Note that the tank contents were sampled during the removal of the tanks in 2000 prior to the RFI field work; however, the results were evaluated in the RFI Report.

Soil and groundwater samples were collected from the vicinity of the former tanks and building slab during the RFI. Several organic and inorganic contaminants were detected in soil, groundwater, and tank contents at concentrations below screening levels. Two polycyclic aromatic hydrocarbons, 2-methylnaphthalene and naphthalene, were detected at concentrations above initial screening levels in groundwater at one temporary monitoring well location, 29TW07 (**Figure 2**). The RFI report concluded that the groundwater impacts were limited in extent, were expected to decrease over time, and were not presenting an unacceptable risk. However, SCDHEC requested groundwater monitoring to ensure that naphthalene and 2-methylnaphthalene detected in groundwater at temporary monitoring location 29TW07 did not increase to unacceptable levels due to potential leaching from soil (SCDHEC, 2008). The RFI included a recommendation to implement the SWMU 29 groundwater monitoring under nearby SWMU 25, which would allow for a NFA decision for SWMU 29. Therefore, the RFI recommended NFA for SWMU 29. The *Corrective Measures Study (CMS) for SWMU 28 – South Annex Building 3818, SWMU 29 – South Annex Building 3820, and SWMU 40 – South Annex Building 3818 Fuel Contamination* was completed in 2010 (TtNUS, 2010). The CMS reiterated the basis for a NFA decision for SWMU 29, and recommended groundwater monitoring to be carried out as part of a groundwater monitoring program for nearby SWMU 25. Installation of a new monitoring well was proposed, since the RFI sampling was completed using temporary monitoring wells. SCDHEC approved the CMS (SCDHEC, 2010).The remedy presented in the approved documents included NFA for SWMU 29, with groundwater monitoring for 2-methylnaphthalene and naphthalene to be implemented under SWMU 25. However, SWMU 25 is within the Air Force Military Munitions Response Program (MMRP), which does not fund routine groundwater monitoring for non-MMRP constituents; therefore, it was determined that the groundwater monitoring for SWMU 29 must be

addressed under the original Environmental Restoration Program site, and that SWMU 29 would not be closed out until monitoring was completed (AFCEC/CZOE, 2015). A permanent groundwater monitoring well, 29MW01, was installed at SWMU 29 in June 2016. The location of 29MW01 is presented in **Figure 2**. Two sampling events in June and October 2016 were conducted to evaluate concentrations of 2-methylnaphthalene and naphthalene at the location of former temporary monitoring well 29TW07. Detected concentrations were screened against the United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for tap water current at the time of the evaluation (i.e., May 2016 RSL update). The RSL for naphthalene is 0.17 micrograms per liter (µg/L) and the RSL for 2-methylnaphthalene is 36 µg/L. The current (June 2017 RSL update) RSLs are the same for these analytes. Naphthalene was not detected in either the June or October 2016 groundwater samples collected from 29MW01. In the duplicate sample collected in June 2016, 2-methylnaphthalene was detected at a concentration of 0.128 µg/L, which is below the project action level (i.e., RSL) of 36 µg/L. 2-Methylnaphthalene was not detected in the parent or duplicate sample collected in October 2016.

Figure 2. SWMU 29 (TU029) Site Map

Installation of the permanent monitoring well 29MW01 and analytical groundwater results were presented in a technical memorandum, the *Groundwater Monitoring Results and Concise Corrective Measures Study Statement for SWMU 29 (TU029)* (Bay West, 2016). The technical memorandum was prepared in place of a separate CMS report for SWMU 29 (TU029), since SWMU 29 (TU029) does not present an unacceptable risk to human health or the environment, and evaluation of corrective measures in a CMS report was not necessary. Therefore, the technical memorandum served as documentation, in place of a CMS, of the groundwater sampling completed in 2016 and recommendation for NFA. SCDHEC approved this recommendation in a response letter dated 15 March 2017.

Summary of SWMU Risks

Several organic and inorganic contaminants were detected in site media and samples of the tank contents at very low levels, and results from the human health and ecological risk assessments conducted as part of the RFI show risks within the acceptable range. Under current and future land use, risk estimates for site receptors (including the future hypothetical resident) do not exceed USEPA human health risk management benchmarks. Concentrations of 2-methylnaphthalene and naphthalene were confirmed to be below project action levels in 2016, and are below the current project action levels (i.e., June 2017 RSL update). Project action levels are established at levels protective of a residential land use scenario. An ecological screening level risk assessment was also completed. Based on the relatively low concentration of contaminants, the poor habitat, and the small size of the site, it was determined that there were no unacceptable risks to ecological receptors from site-related contaminants. Based on the current and historical information, SWMU 29 presents no unacceptable risk for any future use.

Proposed Corrective Action
NFA is proposed for SWMU 29.

Anticipated Impacts of Cleanup on the Local Community
No significant impacts to the local community are associated with the proposed NFA at SWMU 29.

SWMU 38: Southside Building 37 Battery Shop
Contaminants: None
Media: None
Proposed Remedy: No Further Action (NFA)

Site Background

SWMU 38 – Southside Building 37 Battery Shop was a machine shop located in the eastern section of the facility that was originally identified in the 1992 RCRA Permit as "SWMU #38, Southside Building 37 Ditch" that included a storm water drainage ditch, associated with Building 37, which was impacted from industrial waste discharges. It was later renamed in the 1995 RCRA Facility Assessment as "Southside Building 37 Battery Shop and Ditch", and the site boundary was expanded to include the soils around the facility and the Battery Storage Area outside of the building. Additionally, because the machine shop operations included parts degreasing and paint stripping, the floor of the building was etched by acid spills, and residues were known to have historically escaped to the storm water conveyance ditch located to the north of Building 37. There was possible dumping of acid outside the building and drained batteries were stored on bare earth west of the building (Tetra Tech, 2000). These activities contributed to the development of the SWMU 38 boundary.

Site Investigations

Several investigations have been conducted at SWMU 38. To determine the presence or absence of contamination and to present the need for further investigation, confirmation sampling (CS) was conducted in 1997. Samples were collected in areas where battery acid may have been dumped outside of the building, in the battery storage area where acid may have leaked from the batteries placed on the ground, and in the storm water ditch where industrial waste and battery acid may have been conveyed. One groundwater sample was also collected in the assumed downgradient location outside of the south corner of Building 37. The results indicated the presence of low-level contamination in the battery storage area and the storm water ditch and led to additional investigation during the Phase II and III CS events in 1998 and 1999. During these investigations, soil concentrations of several polycyclic aromatic hydrocarbons (PAHs) and tetrachloroethene (PCE) exceeded residential risk-based criteria and soil screening levels (SSLs) at two surface soil locations. As a result, an Interim Measure (IM) to remove the contaminated surface soil in the battery storage area and storm water ditch sediments was recommended.

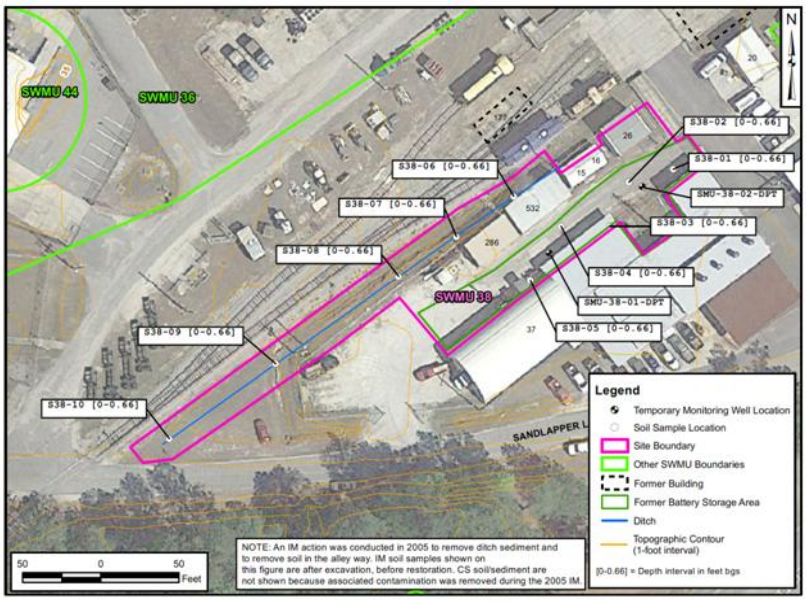


Figure 2. SWMU 38 (ID008) Site and Sample Location Map

IM activities were completed at SWMU 38 (ID008) in 2005 (TolTest, 2005), which included the excavation of 410 cubic yards of asphalt/soil/gravel from the alleyway between Buildings 37 and 286 and the adjacent drainage ditch to a depth of 1 foot below ground surface (bgs). Five confirmatory soil samples collected from the alleyway area following the IM were analyzed for Appendix IX volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Five confirmatory samples collected from the drainage ditch were analyzed for Target Analyte List (TAL) metals. Groundwater samples were also collected during the IM. Two temporary monitoring wells (SMU-38-01-DPT and SMU-38-02-DPT) were installed on the northwestern side of Building 37 in the alleyway to further investigate a detection of lead encountered previously during the CS. A sample location map is provided as **Figure 2**.

All the previously collected data and the results of the IM were summarized and presented in the SWMU 38 RFI (Tetra Tech, 2011b). Following the IM excavation activities, confirmation sampling was conducted prior to paving the battery storage area and restoring the storm water ditch. One SVOC (dibenzo[a,h]anthracene) and one metal (chromium) slightly exceeded screening criteria (United States Environmental Protection Agency [USEPA] residential soil criteria and facility background) at one surface soil location. In addition, one SVOC (naphthalene) and one metal (lead) were detected in groundwater at concentrations exceeding screening criteria at one location. The RFI recommended no further investigation of the site and the application of Land Use Controls (LUCs) until current operations at Building 37 were terminated or operations changed.

A CMS was completed in 2011 (Tetra Tech, 2011b). SCDHEC conditionally approved the CMS and made a recommendation to complete a SWMU 38 CMS Work Plan that would better describe the SWMU 38 site history, define the SWMU 38 boundary, and provide rationale for the application of LUCs on an operational building.

During the preparation of the CMS Work Plan, a site reconnaissance was conducted by Tetra Tech to document current site use as a forklift maintenance facility. There is no longer a battery storage area outside of Building 37, and the facility is not used for battery storage, maintenance, or disposal. A hydraulic lift system that continues to operate within the building was managed by the Underground Storage Tank (UST) program (UST 17433) due to a prior leak identified with the system. Additionally, the sanitary wastewater piping within Building 37 is connected to the sanitary sewer and there are no septic tanks associated with Building 37. Best management practices are in place and there is no disposal of liquids outside of the building. Current industrial operations conducted at Building 37 consist solely of forklift maintenance.

The soil and groundwater data collected during the IM was also reevaluated during preparation of the SWMU 38 CMS Work Plan. Since completion of the RFI, project action levels (PALs) and background concentrations have been updated to reflect the most recent screening criteria and background concentrations. As a result, there are no exceedances of the PAL or the background concentration for any target analytes in soil samples collected at SWMU 38, and only the concentration of naphthalene in one groundwater sample (0.56 micrograms per liter [µg/L]) exceeds its PAL (0.17 µg/L).

Summary of SWMU Risks

During preparation of the CMS Work Plan, Tetra Tech reevaluated the SWMU 38 data and found that there are no exceedances of the PAL or the background concentration for any target analytes in soil samples collected at SWMU 38. For groundwater, human health risks from exposure to naphthalene are within USEPA's acceptable range. Soil and groundwater concentrations at SWMU 38 are below any levels of risk concern.

Proposed Corrective Action

NFA is the proposed remedy for SWMU 38.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 38.

SWMU 40 – South Annex Building 3818 Fuel Contamination
Contaminants: None
Media: None
Proposed Remedy: No Further Action (NFA)

Site Background

SWMU 40 – South Annex Building 3818 Fuel Contamination is in the South Annex of JBC Weapons adjacent to Goose Creek. The site was identified during a water pipeline repair effort when fuel (reportedly diesel fuel) was encountered. A groundwater sample collected from this location contained naphthalene at a concentration of 400 micrograms per liter (µg/L). Three potential sources of the fuel were discussed in the RFI Report (TtNUS, 2008): an underground storage tank (UST), an aboveground storage tank (AST), and a former carpenter and jointer shop that was located to the west of SWMU 40. The date of the repair and fuel discovery is unknown, but it occurred prior to 1995. Naphthalene was not detected during the RFI conducted in 2004; however, methyl tert-butyl ether (MTBE), a gasoline additive, was detected in groundwater.

The nearest known tank (approximately 300-400 feet away) was a fuel oil UST located adjacent to the northwest corner of Building 3817. The UST has been removed; however, records describing the removal are not available. The AST was located west of Building 3814. This AST is not considered a likely source for the SWMU 40 MTBE detection because a release from this tank would have been visible and documented. This AST has been fully removed. Finally, a carpenter and jointer shop was previously located west of SWMU 40. This shop had a slop tank that used diesel fuel to aid pentachlorophenol permeation into the wood during the wood treatment process (TtNUS, 2008). **Figure 2** shows the site layout.

Site Investigation

Twelve temporary monitoring wells were sampled during the RFI conducted in 2004. The evaluation of groundwater detections was documented in the *Phase I and Phase II RFI Report – SWMUs 25, 28, 29, 40 and Confirmatory Sampling Report – SWMU 71 and AOC H* (TtNUS, 2008). MTBE was detected at one temporary monitoring well location, 40TW06, at a concentration exceeding the United States Environmental Protection Agency (USEPA) Drinking Water Advisory Level. MTBE was not detected in any other samples. The risk assessment found no unacceptable risks for human health or ecological receptors. Based on the results of the groundwater investigation, investigation of soil at SWMU 40 was not warranted. SCDHEC requested groundwater monitoring due to the detection of MTBE above the USEPA Drinking Water Advisory Level at temporary monitoring well location 40TW06. The RFI included a recommendation to implement the SWMU 40 groundwater monitoring under nearby SWMU 25, which would allow for a NFA decision for SWMU 40. The *Corrective Measures Study (CMS) for SWMU 28 – South Annex Building 3818, SWMU 29 – South Annex Building 3820, and SWMU 40 – South Annex Building 3818 Fuel Contamination* was completed in 2010 (TtNUS, 2010). The CMS reiterated the basis for a NFA decision for SWMU 40, and recommended groundwater monitoring to be carried out as part of a groundwater monitoring program for nearby SWMU 25. Installation of a new monitoring well was proposed, since the RFI sampling was completed using temporary monitoring wells. The CMS was approved by SCDHEC (SCDHEC, 2010).The remedy presented in the approved documents included NFA for SWMU 40, with groundwater monitoring for MTBE to be implemented under SWMU 25. However, site SWMU 25 is within the Air Force Military Munitions Response Program (MMRP), which does not fund routine groundwater monitoring for non-MMRP constituents; therefore, it was determined that the groundwater monitoring for SWMU 40 must be addressed under the original Environmental Restoration Program site, and that SWMU 40 would not be

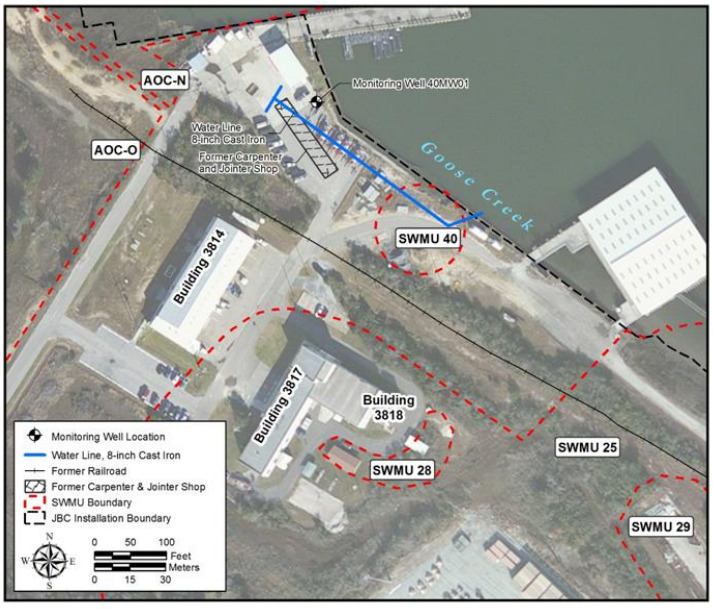


Figure 2. SWMU 40 (CG040) Site Map

closed out until monitoring was completed (AFCEC/CZOE, 2015). A permanent groundwater monitoring well, 40MW01, was installed at SWMU 40 in June 2016. The location of 40MW01 is presented in **Figure 2**. Two sampling events in June and October 2016 were conducted to evaluate concentrations of MTBE at the location of former temporary monitoring well 40TW06. Detected concentrations were screened against the USEPA Regional Screening Levels (RSLs) for tap water current at the time of the evaluation (i.e., May 2016 RSL update). The RSL for MTBE is 14 micrograms per liter (µg/L). The current (June 2017 RSL update) RSL is the same for MTBE. MTBE was detected at concentrations ranging from 1.77-2.37 µg/L in the June and October 2016 groundwater samples collected from 40MW01. The detected concentrations are below the project action level (i.e.,RSL) of 14 µg/L for MTBE.

Installation of the permanent monitoring well 40MW01 and analytical groundwater results were presented in a technical memorandum, the *Groundwater Monitoring Results and Concise Corrective Measures Study Statement for SWMU 40* (Bay West, 2017). The technical memorandum was prepared in place of a separate CMS report for SWMU 40, since SWMU 40 does not present an unacceptable risk to human health or the environment, and evaluation of corrective measures in a CMS report was not necessary. Therefore, the technical memorandum served as documentation, in place of a CMS, of the groundwater sampling completed in 2016 and recommendation for NFA. This recommendation was approved by SCDHEC in a response letter dated 15 March 2017.

Summary of SWMU Risks

Several organic contaminants were detected in site groundwater, and results from the human health risk assessment conducted as part of the RFI show risks within the acceptable range. Under current and future land use, risk estimates for site receptors (including the hypothetical future resident) do not exceed USEPA human health risk management benchmarks. Concentrations of MTBE were confirmed to be below project action levels in 2016, and are below the current project action levels (i.e., June 2017 RSL update). Project action levels are established at levels protective of a residential land use scenario. An ecological screening level risk assessment was also conducted for SWMU 40 to assess potential impacts, if any, to aquatic organisms from groundwater discharging into Goose Creek. Since the contamination was confined to the subsurface, there was no potential risk for terrestrial receptors. Considering the results of the screening, as well as additional factors including background data, dilution, and surface water and sediment data from nearby Goose Creek, it was determined that the potential for ecological risk posed by SWMU 40 groundwater analytes was not significant. Based on the current and historical information, SWMU 40 presents no unacceptable risk for any future use.

Proposed Corrective Action

NFA is proposed for SWMU 40.

Anticipated Impacts of Cleanup on the Local Community

No significant impacts to the local community are associated with the proposed NFA at SWMU 40.

SWMU 78: Northside Demil Facility Building
Contaminants: None
Media: None
Proposed Remedy: No Further Action (NFA)

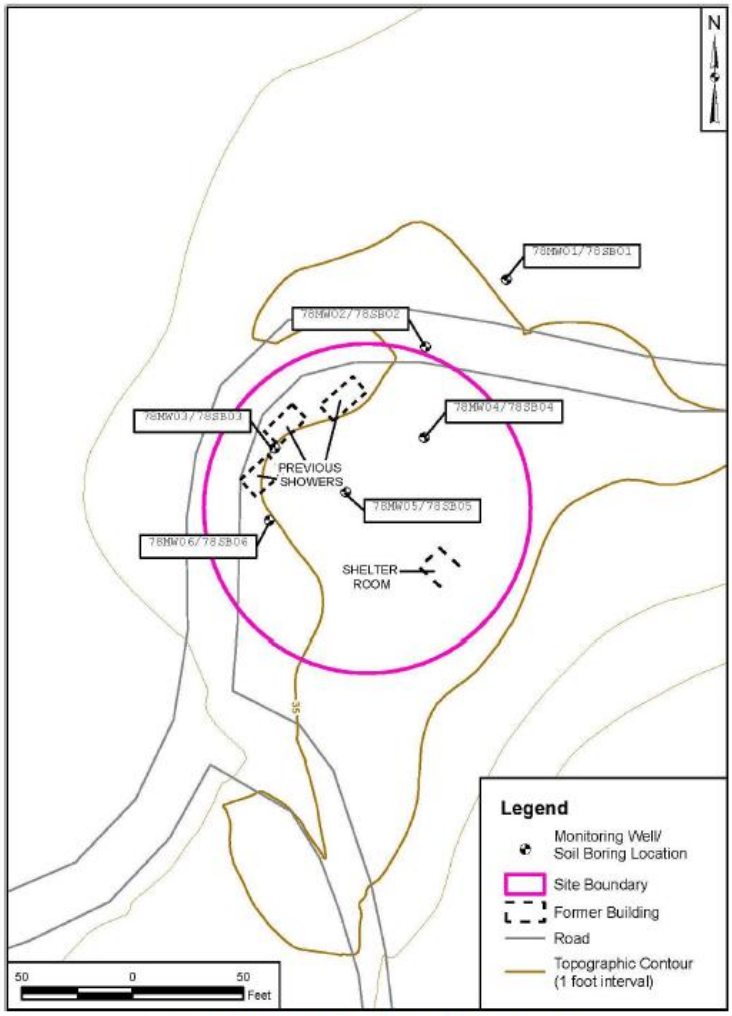


Figure 2. SWMU 78 (ID078) Site and Sample Location Map

Site Background

SWMU 78 is a former ammunition demilitarization site that consists of a cleared area less than 0.5 acres (approximately 120 feet by 120 feet) adjacent to an undeveloped dirt road and surrounded by woods. The site is located in the northwestern portion (POMFLANT area) of JBC Weapons (approximately 500 feet north of the POMFLANT access road), and operated from 1941 to 1953. The site was a multi-celled concrete structure where ammunition was dismantled prior to washout operations. A site map of SWMU 78 is included as **Figure 2**.

Site Investigations

Several investigations have been conducted at SWMU 78. A RCRA Facility Assessment (RFA) was completed in 1997 (WPNSTA Charleston, 1997). During the RFA, one soil sample was collected which was analyzed for explosives and metals. Explosives were not detected; only the arsenic concentration exceeded its residential screening criterion but was less than the facility background concentration. Although no contamination was detected, the RFA report recommended additional sampling to evaluate whether there had been a release at the site. An Interim Measure (IM) was conducted in 2005. The concrete structures were demolished and the construction materials were recycled or disposed (TolTest, 2005). Following the IM, confirmatory surface and subsurface soil samples were collected and six temporary wells were installed and sampled. One polycyclic aromatic hydrocarbon (PAH) in soil, benzo(a)pyrene, was detected at a concentration greater than the residential screening criterion; and one semi-volatile organic compound (SVOC) in groundwater, bis(2-ethylhexyl)phthalate (BEHP), was detected at concentrations greater than screening criteria and background. No further investigation of the nature and extent of soil and groundwater contamination was recommended after the IM for SWMU 78 because few analytes were detected at concentrations greater than screening criteria and background in place at the time. To complete the understanding of the site, an investigation of water levels and groundwater flow direction was recommended.

A RFI was conducted in 2009 (Tetra Tech, 2011a). Three piezometers were installed to determine groundwater flow direction at SWMU 78; no analytical data were collected from the piezometers. No further action was recommended for soil and groundwater in the conditionally approved RFI Report.

A CMS was completed in 2011 (Tetra Tech, 2011b). The CMS report recommended NFA for soil and groundwater at SWMU 78 based on the results of the IM confirmatory sampling and the additional data collected during the RFI. However, to support the final site recommendation of NFA, SCDHEC required additional data collection to confirm the presence or absence of explosives, BEHP, and PAHs in soil; and

BEHP and PAHs in groundwater. SCDHEC conditionally approved the CMS Report on the basis that the investigation would be conducted.

Based on comments received from SCDHEC on the conditionally approved 2011 CMS report, a CMS Work Plan was developed to confirm the presence or absence of contamination in soil and groundwater at SWMU 78 (Tetra Tech, 2016). During the 2016 CMS Investigation, six permanent monitoring wells were installed. Surface and subsurface soil samples were collected from each monitoring well boring, and a groundwater sample was collected from each monitoring well (Tetra Tech, 2017). A sample location map is provided as Figure 2. Explosives, BEHP, and PAHs were either not detected or were detected at concentrations below project action levels (PALs) in soil and groundwater.

Summary of SWMU Risks

During the 2016 CMS Investigation risk screening, data were screened for the hypothetical future residential scenario and no chemicals of potential concern (COPCs) were identified. Therefore, further evaluation of risks was not required. Soil and groundwater concentrations at SWMU 78 are below any levels of risk concern.

Proposed Corrective Action

NFA is the proposed remedy for SWMU 78.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 78.

SWMU 80 – South Annex Dump Site
Contaminants: None
Media: None
Proposed Remedy: No Further Action (NFA)

Site Background

SWMU 80 is located in the South Annex, north of Wilkinson Way and the Grace Hopper Bridge. Historical documents indicate SWMU 80 (DA037) was likely used as a solid waste debris dumpsite, and the site is identified on the installation's RCRA Permit as the South Annex Dump Site. Three small "pickup sized loads" of debris piles were located at the site. Two of the debris piles contained metal siding, linoleum flooring, and fiberglass insulation; there was evidence of metal pipes, beams, and concrete rubble on the surface at the third debris pile. There was no evidence of trenching or subsurface disposal at the site. This location was reportedly used as a general dump site for trash in the late 1960s and early 1970s. The dump site was reportedly accessed by trucks, with employees backing down the road to dump general office debris. Based on the limited number of debris piles identified (i.e., three piles), it does not appear this dumping was conducted often.

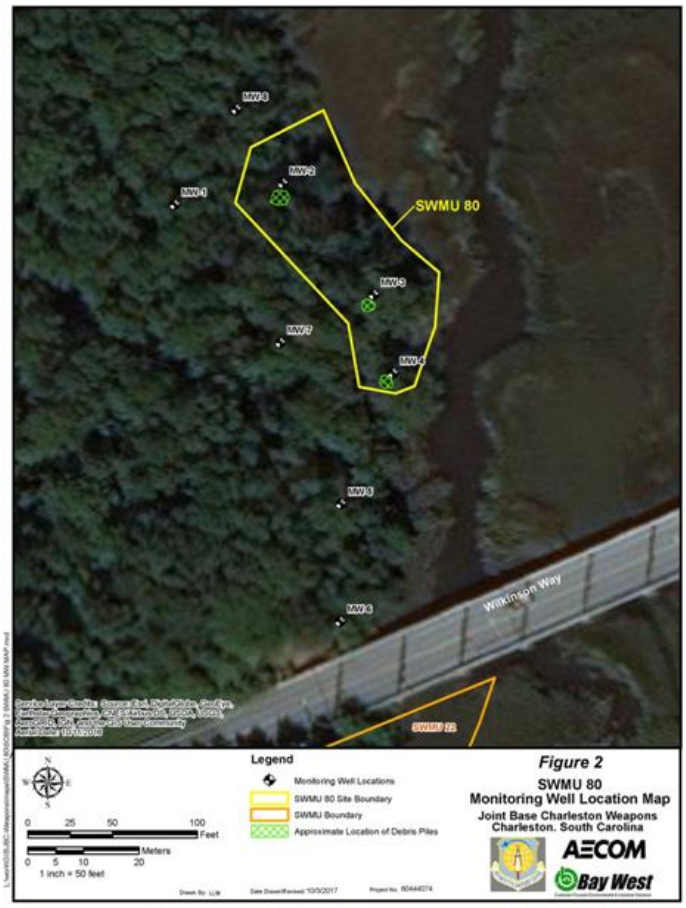


Figure 2. Site Map of SWMU 80 (DA037) – Joint Base Charleston Weapons, SC

Site Investigations

In 2001, as part of the RCRA Facility Assessment, a single surface soil sample was collected from the site and analyzed for a wide range of constituents. The results of the analyses indicated the presence of polynuclear aromatic hydrocarbons (PAHs) and arsenic at concentrations slightly above residential screening levels. Based on the results, NFA was recommended for SWMU 80. SCDHEC disagreed with the NFA recommendation, and SWMU 80 was subsequently included in Appendix A of the installation's RCRA Permit as requiring a RCRA Facility Investigation (RFI).

In 2012, the RFI was conducted. A total of three soil borings were installed, with one soil boring next to each of the three debris piles. Two soil samples (one surface and one subsurface) were collected from each boring location. After soil boring samples and boring log data were collected, four shallow monitoring wells were installed using the hollow-stem auger drilling technique. Three permanent monitoring wells were installed within the potential source areas (debris piles), and a fourth monitoring well was installed in a location perceived to be hydraulically upgradient from the debris piles.

No constituents of potential concern (COPCs) were identified in surface soil. Thallium was identified as a COPC in subsurface soil because it was detected at a concentration above the risk-based protection of groundwater screening level; it did not exceed the direct contact screening level for human health risk. Thallium was not detected in groundwater at the site. In addition, thallium was not detected in surface soil, which would have been an indicator that it had been released from the debris piles on the surface. Therefore, thallium was not retained as a constituent of concern (COC) in subsurface soil at SWMU 80.

Arsenic, beryllium, cadmium, cobalt, copper, mercury, nickel, and zinc were identified as COPCs in groundwater. However, beryllium was the only COPC that exceeded its maximum contaminant level (MCL)

in groundwater. Beryllium was not detected in soil above residential screening levels or facility background concentration. It was detected in the site background well, suggesting that it occurs naturally in groundwater at SWMU 80. Based on the background well result, the beryllium detected in the site wells does not appear to originate from a release from the debris piles on the site. However, since beryllium concentrations in groundwater exceeded the MCL, a corrective measures study (CMS) to evaluate remedial alternatives for metals in groundwater was recommended.

In a letter dated August 8, 2014, SCDHEC agreed with the recommendation to prepare a CMS to evaluate remedial alternatives for metals in groundwater, and agreed that it is likely that the source of elevated concentrations of beryllium is naturally occurring. However, because the background well installed during the RFI was found not to be hydraulically upgradient from SWMU 80 (DA037), SCDHEC "must assume that the beryllium is site-related."

In August 2016, additional RFI work was conducted at SWMU 80 which included the installation of four additional monitoring wells at locations assumed to be upgradient or side-gradient background locations and collection of groundwater samples from all eight SWMU 80 wells. The groundwater samples were analyzed for metals and the results were compared to MCLs and screening levels. Three metals (arsenic, beryllium, and cobalt) were detected at concentrations above their respective MCL or screening level. However, the concentrations of these metals were less than JBC Weapons background concentrations (Tetra Tech, 2017). A geochemical evaluation also showed that the elevated concentrations of arsenic, beryllium, and cobalt were due to these elements naturally occurring in site soils and leaching to groundwater because of pH conditions. In addition, a statistical evaluation was conducted to compare the beryllium and cobalt concentrations detected in the three SWMU 80 wells installed within the debris piles with the concentrations in the background wells installed around SWMU 80. Because arsenic concentrations did not exceed its MCL in any site wells (the only well in which the arsenic MCL was exceeded was a background well), arsenic was not included in the statistical evaluation. The statistical evaluation showed that the beryllium and cobalt concentrations in the debris area wells did not exceed the concentrations in the background wells. Therefore, it was shown that the detected concentrations of these metals in groundwater at SWMU 80 are naturally-occurring and not related to site activities (AECOM, 2017).

In January and February 2017, the surface debris at SWMU 80 was removed from the site and properly disposed.

Since the debris piles have been removed from SWMU 80 and it does not appear that the debris piles impacted groundwater or soil at SWMU 80, a recommendation of NFA was proposed for SWMU 80 in the RFI Addendum/Interim Measures Report for SWMU 80 (AECOM, 2017). SCDHEC approved this recommendation in an approval letter dated August 18, 2017.

Summary of SWMU Risks

The debris piles have been removed from SWMU 80 and no COCs were identified in soils. Groundwater COC concentrations in site monitoring wells have been shown to be naturally occurring and do not exceed concentrations detected in site-specific upgradient background monitoring wells. Based on the historical and current information, SWMU 80 presents no unacceptable risk to human health and the environment for any future use.

Proposed Corrective Action

NFA is the proposed remedy for SWMU 80.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 80.

SWMU 84 – Drum Disposal Area – 8th Street and Brig Road
Contaminants: None
Media: None
Proposed Remedy: No Further Action (NFA)

Site Background
Six buried 55-gallon drums were discovered at the Old South Annex Waste Disposal Area during construction activities in 2006. The area was not designated as a SWMU at that time, and no records of the existence or contents of the drums were available. The site was subsequently named SWMU 84, and drum removal activities were initiated. SWMU 84 is located on the 7th Street and 8th Street blocks of Brig Road in the South Annex area of JBC Weapons. The site was previously a wooded area, but it is currently covered by an asphalt parking lot (**Figure 2**).

Site Investigations

Following the discovery of the six drums, a geophysical survey was conducted to estimate the size of the investigation area and determine the approximate number of buried drums. The results of the geophysical survey (GE&E, 2006) indicated the area of buried material was limited to the area around the six identified drums.

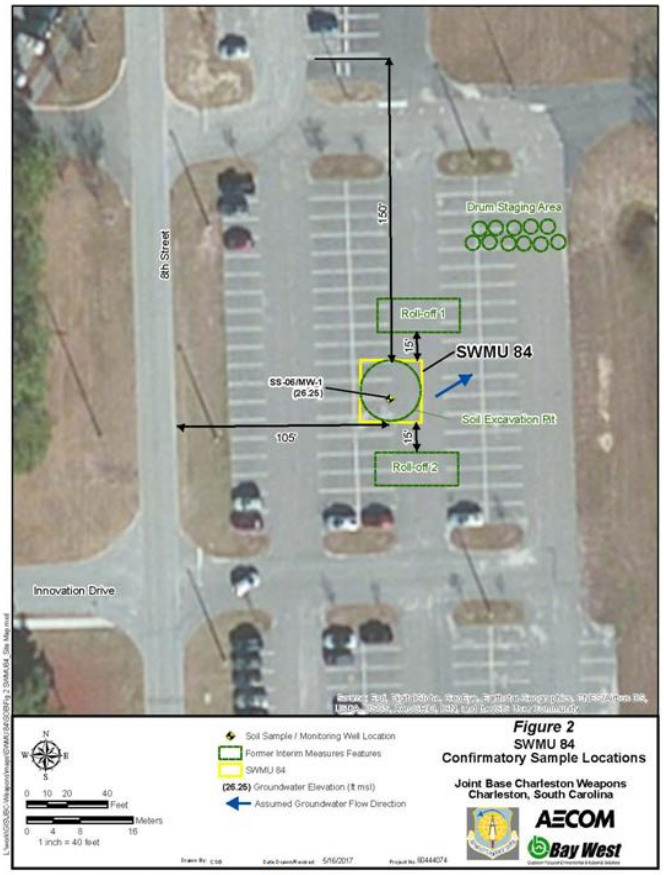


Figure 2. Site Map of SWMU 84 (LF041) – Joint Base Charleston Weapons, SC

After the geophysical survey was completed, a backhoe was mobilized to the site in March 2006 to remove the drums and potentially impacted soil surrounding the drums. During removal activities, a total of 11 drums were uncovered. The drums were removed, overpacked, and transported off-site for disposal. Surrounding soil suspected of having been impacted by these drums was removed and placed in two roll-off boxes prior to being transported off-site for disposal. The drums were found at depths ranging from 3–7 feet (ft) below ground surface (bgs). Initial assessment during removal activities indicated that most of the drums were unlabeled and deteriorated. Four of the drums contained aqueous contents described as paint possibly mixed with paint thinner/remover.

Samples were collected from each of the drums prior to disposal. The specific analytical suite for each sample was determined based on inspection of the drum contents and knowledge of former industrial operations at the former Charleston Army Depot (now referred to as the South Annex). For example, pesticide analysis was not conducted on samples from drums determined in the field to contain paint (GE&E, 2006). The analytical results for the samples were used to classify the waste for disposal. Three of the drums (Drum Numbers 3, 7, and 9) were classified and disposed as hazardous waste. The remaining eight drums and excavated soils were classified and disposed as non-hazardous waste.

Once the drums and the surrounding soil were removed, confirmation soil samples from the excavation pit were collected from five locations. The location of the excavation pit is shown on **Figure 2**. The confirmation soil samples were collected from undisturbed soil at the base of the excavation (approximately 6–8 ft bgs) using a backhoe. In addition to samples from the excavation pit, composite samples of excavated soil within each of the two roll-offs were collected. No constituents were detected in the confirmation soil samples at concentrations that exceeded their screening levels.

Based on these analytical results, the excavated soil was classified as non-hazardous waste and transported off-site for disposal. Additionally, since the excavation area was to be covered with an asphalt

parking lot, reducing the risk of constituents leaching into the groundwater, the IM Report (GE&E, 2006) recommended that no additional assessment or remediation activities be conducted for site soil.

In a letter dated March 7, 2007, SCDHEC approved the revised IM Report and outlined land use controls required at that time. SWMU 84 was subsequently included in the *Performance of a Periodic Review (13 Sites) at Joint Base Charleston Weapons* (Aerostar Environmental Services, 2014). In the review letter of this document dated September 5, 2014, SCDHEC stated "A remedy for SWMU 84 has not yet been selected. SWMU 84 is included in Table A-4 of the RCRA Permit for JBC Weapons as requiring confirmatory sampling."

In August 2016, AECOM installed one soil boring and one monitoring well within the area of the former soil excavation pit to confirm the results from the IM sampling conducted in 2006 following the removal of the drums and surrounding soils. The location of the former soil excavation pit was derived from measurements and sketches provided in the IM Report (GE&E, 2006). A soil sample was collected from the native soil below the IM excavation backfill, and a groundwater sample was collected from the monitoring well. The soil and groundwater samples were sent to an analytical laboratory for analysis. The results of the analyses determined that no constituents in the soil sample exceeded their residential screening levels and no constituents in the groundwater sample exceeded South Carolina or Federal Maximum Contaminant Levels (MCLs). The Confirmatory Sampling Report (AECOM, 2017) served as documentation of the soil and groundwater sampling completed in 2016 and recommended NFA for SWMU 84. SCDHEC approved this recommendation in a response letter dated April 28, 2017.

Summary of SWMU Risks

The buried drums and surrounding soils were excavated and properly disposed in 2006. The excavated area was backfilled with clean fill and an asphalt parking lot was installed over the area. No constituents were detected at concentrations above residential or industrial screening levels in the soil confirmation soil samples collected from the base of the excavation in 2006. In addition, confirmatory soil and groundwater samples were collected in 2016, and no constituents were detected above residential screening levels in soil or above MCLs in groundwater. Based on the historical and current information, SWMU 84 presents no unacceptable risk to human health and the environment for any future use.

Proposed Corrective Action

NFA is the proposed remedy for SWMU 84.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at SWMU 84.

AOC B-4 – Building 324
Contaminants: None
Media: None
Proposed Remedy: No Further Action (NFA)

Figure 2. Site Map of AOC B-4 (TU923/Building 324) – Joint Base Charleston Weapons,

Site Background

AOC B-4 is used as the General Motor Pool maintenance facility, located in the POMFLANT area of the north side of the JBC Weapons facility (**Figure 2**). The site is used for the inspection and maintenance of JBC Weapons vehicles (Advent, 2013). A 10,000-gallon steel fuel oil UST was located east of the building (**Figure 2**). The former steel UST was used to supply fuel oil to a boiler inside the building. The steel UST was removed in 1994 and replaced with an upgraded fiberglass fuel oil UST. The fiberglass UST was installed in the same basin as the former steel UST. Soil and groundwater samples collected at the time of the removal of the former steel UST did not identify significant petroleum contamination. SCDHEC did not require further assessment at that time, as per their letter dated April 29, 1997.

In 1998, a surface release of fuel oil occurred as a result of a failed aboveground pipe joint associated with the new fiberglass UST. The petroleum-impacted surface soil was excavated immediately following the release. Following excavation and backfill activities, soil samples were collected from soil borings at the soil surface and immediately above the water table to determine if residual petroleum contamination was present from the surface release. The soil sampling identified petroleum contamination present in surface soil and at a depth of 4 feet (ft) below ground surface (bgs) (Albrecht, 1999). According to the January 1999 Report of Findings (Albrecht, 1999), petroleum contamination was believed to be caused by the 1998 release or residual contamination from the former steel UST, which had not been detected at the time of closure. SCDHEC requested additional assessment activities be conducted at the site.

Site Investigations

In 2000, a Hydrogeologic Assessment (HA) of the site was performed. During this assessment, 8 soil borings and 11 temporary monitoring wells were installed at the site. Soil samples were collected from the soil borings, groundwater samples were collected from the 11 temporary wells, and slug tests were performed to determine the hydraulic characteristics of the unconfined aquifer. Three temporary monitoring wells (MW-1, MW-2, and MW-9) identified free phase petroleum product on groundwater. Based on analytical results and direction of groundwater flow, six monitoring wells (MW-3, MW-4, MW-6, MW-7, MW-10, and MW-11) were converted to permanent wells. Wells MW-5 and MW-8 were abandoned, while MW-1, MW-2, and MW-9 were left in place until the scheduled abandonment of the existing fiberglass UST (GE, 2000).

In January 2001, a Corrective Action Plan (CAP) was submitted outlining the removal and disposal of the fiberglass UST and associated piping, concrete pad, tank pit, and contaminated soil (EEG, 2001). In March 2001, the UST, groundwater, free product, temporary monitoring wells, and visually impacted soils in the

immediate vicinity of the fiberglass UST (**Figure 2**) were removed. New monitoring wells NWS324 MW-9, NWS324 MW-10, and NWS324 MW-11 were installed following removal activities. A Tank Closure Assessment Report was submitted to SCDHEC in July 2001 presenting the removal activities performed in accordance with the CAP. The Tank Closure Assessment Report indicated the source of contamination at this site was a failed piping joint in the pump house building located at one end of the former fiberglass UST (Naval Weapons Station Charleston, 2001).

In 2003, SCDHEC authorized the facility to conduct an aggressive fluid vapor recovery (AFVR) event at three monitoring wells: NWS324 MW-9, NWS324 MW-10, and NWS324 MW-11. The objective of the AFVR event was to remove contaminated groundwater from these wells. A report detailing the results of the 2003 AFVR event is not available in the historical record for the site. However, a significant decrease in benzene, a component of fuel oil, from concentrations above the maximum contaminant level (MCL) to concentrations below the MCL occurred at the site in 2003 in some monitoring wells. This may be attributed the 2003 AFVR event.

From 2002 to 2014, groundwater sampling occurred at all the existing groundwater monitoring well locations at the site (**Figure 2**). Additional monitoring wells, MW-12 and NWS324 MW-13, were installed in 2006 and 2007, respectively, to further delineate the groundwater plume at the site. Groundwater samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX), methyl tert-butyl ether (MTBE), naphthalene, and methane. From 2003 to 2011, naphthalene was the only contaminant of concern (COC) in any well detected at concentrations in excess of the SCDHEC Risk Based Screening Level (RBSL). Since 2011, all naphthalene concentrations in all monitoring wells have been below its RBSL.

In a letter dated July 7, 2015, SCDHEC expressed concern for the potential of a continuing source of naphthalene in soil still leaching to groundwater near well NWS324 MW-11 since naphthalene concentrations fluctuated significantly between 2003 and 2011. In January 2016, two soil samples were collected from either side of NWS324 MW-11 and analyzed for naphthalene. Naphthalene was not detected in either soil sample. A Soil Investigation Report was submitted to SCDHEC in April 2016 (AECOM, 2016).

Based on the findings from the soil samples and decreasing groundwater trends, no significant potential health risks for human receptors were identified, and as stated in the Soil Investigation Report, NFA was recommended for AOC B-4. In a letter dated June 8, 2016, SCDHEC deemed the Soil Investigation Report to be technically adequate, and concurred with the recommendation of NFA for AOC B-4.

Summary of AOC Risks

The fiberglass UST was excavated, removed, and properly disposed of in March 2001. The excavated tank basin was backfilled with clean soil. Groundwater COCs have not been detected above RBSLs since 2011 and no COCs were detected above residential RBSLs during the Soil Investigation in 2016. Based on the finding that there is no soil contamination above RBSL and therefore no risk for any future land use, NFA is the proposed remedy for AOC B-4.

Proposed Corrective Action

NFA is the proposed remedy for AOC B-4.

Anticipated Impacts of Cleanup on the Local Community

No impacts to the local community are associated with the proposed remedy at AOC B-4.

SWMU 18: Southside Open Burn/Open Detenation (OB/OD) Facility
Contaminants: Barium and potential munitions and explosives of concern (MEC) hazards
Media: Sediment and soil
Current Post-Closure Activities: The proposed post-closure activities include land use controls (LUCs), groundwater monitoring, and maintenance of the existing biological barrier.
Modified Post-Closure Activities:

- Discontinuation of groundwater monitoring and abandonment of groundwater monitoring wells; and
- Reduction in the frequency of LUC inspections from semi-annual to annual.

Site Background

SWMU 18 (XU018) comprises approximately 5 acres and is bounded by woods to the north and northeast, by Torpedo Road to the east, by a gravel road to the south and southwest, and by a marsh to the west (**Figure 2**). SMWU 18 (XU018) was used for OB/OD operations between 1965 and 1987, in which various types of munitions and explosives were thermally treated. OB/OD activities may have also taken place at the site prior to 1965. During OB operations, ordnance was burned either on the ground surface or within a small furnace. Burn operations at SWMU 18 (XU018) were restricted to a maximum of 350 pounds net explosive weight per burn.

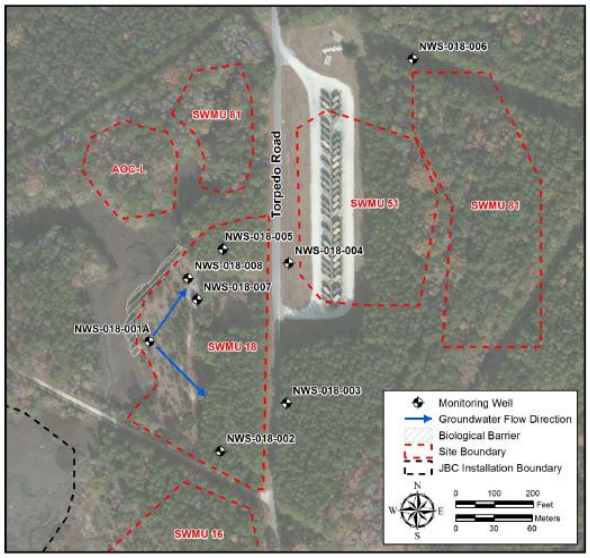


Figure 2. SWMU 18 (XU018) Site Layout

OD operations occurred primarily in the eastern portion of the facility in detonation pits, which were dug to safely contain ordnance during disposal. At the termination of site operations, there were seven active detonation pits ranging from 3 to 15 feet in diameter, and 2 to 3 feet deep. As a Class C range, the unit was limited to 150 pounds per detonation. Types of ammunitions and explosives treated through OD included, but were not limited to, explosive-loaded grenades, projectiles, and mortar ammunition. In addition to OB/OD activities, it was reported in the Initial Assessment Study and RCRA Facility Assessment that an estimated 80 to 100 cases of mercury batteries were buried at SWMU 18 (XU018) in 1973 (Ensafe, 2003). RCRA closure of SWMU 18 (XU018) was implemented in accordance with an approved Closure Plan (Ensafe, 1999). The Closure Plan Amendment was submitted to the Department April 2018.

Proposed Modification to Post-Closure Activities

The current post-closure activities for SWMU 18 consist of an in-situ cap for soils, groundwater monitoring and maintenance of the existing biological barrier, and LUCs. The proposed modification to the post-closure activities include the discontinue of groundwater monitoring, but the site will still have restrictions for the installation of drinking water wells, and a reduction in LUC inspections from semi-annually to annually.

Anticipated Impacts of Cleanup on the Local Community

No significant impacts to the local community are associated with the proposed remedy at SWMU 18.